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# THIRTY-EIGHTH

## ANNUAL REPORT OF THE SECRETARY

OF THE

## MASSACHUSETTS

# BOARD OF AGRICULTURE,

TOGETHER WITH THE

## EIGHTH ANNUAL REPORT OF THE STATE AGRICULTURAL EXPERIMENT STATION.

## 1890.

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Office of the Secretary, Commonwealth Building, Boston.

# THE THIRTY-EIGHTH ANNUAL REPORT

OF THE

## SECRETARY

OF THE

# BOARD OF AGRICULTURE.

*To the Senate and House of Representatives of the Commonwealth of Massachusetts.*

Most of the work of the Board of Agriculture has been along the usual line of effort in past years, but new avenues of usefulness are continually opening. It has been our endeavor to keep abreast of the times, and meet these new calls as far as time and the facilities of the office will allow.

The year past has been one of average prosperity to the agricultural interests of the State.

### The Weather.

The winter of 1889–90 was unusually mild. Bulletin No. 36 of the State Agricultural Experiment Station at Amherst states that "the mildness of the four months ending Feb. 28, 1890, was without a parallel since the beginning of the weather records at Amherst in 1836.

"The mean temperature for each of the months mentioned was considerably above the average. No ice was cut until February, when it was from six to eight inches in thickness. The periodical snow fall was light, with the exception of the one on the 20th of February, which offered a chance for sleighing for a few days. A snow storm on the 6th of March

also gave good sleighing for a few days. The temperature for April was above the average; the rainfall was considerably less. The last heavy frost of the season occurred April 29."

At Amherst the highest temperature in January was 61.5°; in February, 59.5°; in March, 59.5°; in April, 77.5°. The lowest temperature in January was 4.5°; in February, 3°; in March, —9.5°; in April, 22°. Mean temperature for January was 30.51°; for February, 30.37°; for March, 30.18°; for April, 45.45°. The total precipitation for January was 2.61 inches; in February, 4.01; in March, 4.81; in April, 1.64 inches. The total snow fall in January was 4 inches; in February, 4.5; in March, 17 inches. The prevailing winds in January and February were north-westerly, and in March and April, north-easterly.

The Blue Hill (Milton) Observatory review of the weather for the month of March states that the month was noteworthy for the exceptionally large snow fall, which was equal in amount to all that had previously fallen since Dec. 1, 1888, notwithstanding the fact that, excepting last year, it was the warmest March in over six years. Storms were more frequent, and the variability of the temperature and rainfall greater than usual.

In Boston the month of April was not an unusual one in point of temperature, the average for the month during twenty years being 45°, the average for April, 1890, being 46°. The extremes of temperature were 72° on the 24th and 26° on the 19th. There was an unusual absence of April showers, the rainfall amounting to 2.30 inches, while the average for twenty years was 3.60. After April 9 there was but one day on which more than one-tenth inch of rain fell. The total deficiency of rain in the four months ending May 1 was 4.31 inches.

The month of May was cool and wet. The average temperature was only slightly below the normal, but the nights were decidedly cool, and numerous frosts occurred. The average temperature of the month of May at Springfield for twenty-three years was 59.3°; the average for May, 1890, was 59°; departure, — 0.3°. There were heavy rains on the 4th, 6th, and 26th to 28th. The amount of precipitation

was in excess. The average precipitation at Springfield for the month of May for forty-three years was 4.17 inches; for May, 1890, 5 36; a departure of + 1.19 inches.

The amount of sunshine was slightly below the normal. The prevailing direction of the wind was south-west. Frosts occurred on the 3d, 17th and 23d. Hail was general on the 28th.

The weather for June was slightly below the normal, both in temperature and precipitation. During the first half of the month it was generally cold, with little sunshine, and with precipitation above the average; but the last half was much warmer, with more sun and little rain. The average temperature for the month of June at Springfield for twenty-three years was 68.2°; for June, 1890, 67.6°; departure, — 0.6°. The average temperature for the month of June at Boston for twenty-three years was 66°; average for June, 1890, 64.2°; departure, — 1.8°.

The average precipitation for the month of June in Springfield for forty-three years was 3.87 inches; for June, 1890, 1.83; departure, — 2.04 inches. The average precipitation in Boston for the month of June for twenty years was 3.29 inches; for June, 1890, 2.21; departure, — 1.08 inches. From the 4th to the 6th considerable rain fell. This was followed by fair weather till the 11th, when there was a marked rise in the temperature, and in some sections frequent thunder storms. The wind changed to north-east on the night of the 11th along the coast, and the temperature fell in some places about thirty degrees from noon of the 11th to noon of the 12th. It continued low till the 16th, the lowest temperature of the month occurring from the 13th to the 16th. Rain was almost continuous during that time, and in some localities in the western part of the State was the last rain of the month; but in the south-eastern part the showers were frequent, though comparatively little rain fell. High temperature occurred on the 18th, 25th and 30th, and the nights during the last two weeks of the month were much warmer than at any time of the season. The prevailing direction of the wind during the month was west.

The month of July was characterized by a severe drouth,

of sunshine, very near the normal in temperature, and below in precipitation and number of rainy days. In Boston it was the dryest November since the signal office observations were begun in 1871, 0.97 inch of rain falling, all during the week ending the 18th. The average rainfall for November for twenty years was 4.78 inches. The temperature averaged 41.8° ; the average for twenty years being 40.3°. At Amherst the total precipitation was 1.19 inches. Snow fell on the 11th, 22d and 23d, — a total fall of 1$\frac{3}{8}$ inches being recorded.

The month of December was the coldest in Boston for ten years ; the average temperature being 26°. The average temperature for the month for twenty years was 30.5°. In Boston 3.72 inches of rain and melted snow fell ; the average precipitation for the month for twenty years being 3.42 inches. The prevailing wind was north-west. The highest temperature was 56°, on the 4th ; the lowest zero, on the 3d. At Amherst the highest temperature was 43.5° ; the lowest, — 5°. The total precipitation was 1.18 inches. Snow fell on the 3d, 5th, 6th, 7th, 18th, 22d, 26th, 27th, 29th and 30th, — total fall being 15$\frac{3}{4}$ inches. Rain fell on the 3d, 6th, 17th, 18th, 21st and 22d.

## Meteorological Observatory of the Hatch Experiment Station, Massachusetts Agricultural College, Amherst.

Latitude, 42° 23′ 48.5″ N. Longitude, 72° 31′ 10″ W. Height of instruments above ground, 51 feet. Above sea level, 260 feet.

### Annual Summary for 1890.

*Pressure.*

[In Inches.]

| | |
|---|---|
| Actual maximum, reading, | 30.64, Jan. 1, 1 A. |
| Actual minimum, reading, | 29.025, Oct. 27, 2 P. |
| Mean reduced to sea level, | 30.03 |
| Annual range, | 1.615 |

* *Air Temperature.*

[In Degrees Fahr.]

| | |
|---|---|
| Highest, | 92; 94, July 8 |
| Lowest, | 2; -6.5, March 7 |
| Mean, | 47.7; 46.9 |
| Annual range, | 90; 100.5 |
| Highest mean daily, | 80; 81 July 31 |
| Lowest mean daily, | 84; 83 Dec. 30 |
| Mean maximum, | 54.3; 57.7 |
| Mean minimum, | 37.4; 35.9 |
| Mean daily range, | 16.8; 21.9 |
| Greatest daily range, | 38; 48.5 April 13 |
| Least daily range, | 2 Feb. 28, 5.5 April 27 |

*Humidity.*

| | |
|---|---|
| Mean dew point, | 40.6 |
| Mean force of vapor, | .4378 |
| Mean relative humidity, | 71.1 |

*Wind.*

[Prevailing Directions.]

| | |
|---|---|
| North, | 15% |
| South, | 11% |
| North-west, | 11% |
| South, south-west, | 10% |
| Total movement, | 54,684 m. |
| Greatest daily movement, | 410 m. April 5 |
| Least daily movement, | 18 m. Feb. 25 |
| Mean daily movement, | 149.6 m. |
| Mean hourly velocity, | 6.2 m. |

Maximum pressure per square foot, 27¾ lbs. = 74 m. per hour, Jan. 8, 3 A.M.

* *Precipitation.*

Total rainfall or melted snow, 39.48 in., 48.5 in.

| | |
|---|---|
| Number of days on which .01 of rain or melted snow fell, | 141 |
| Total snow fall, in inches, | 43½ |

*Weather.*

| | |
|---|---|
| Mean cloudiness observed, | 57% |

Total cloudiness recorded by the sun thermometer, 2,279 hours, or 51%.

| | |
|---|---|
| Number of clear days, | 137 |
| Number of fair days, | 105 |
| Number of cloudy days, | 123 |

*Bright Sunshine.*

| | |
|---|---|
| Number of hours recorded, | 2,194 |
| Mean ozone, | 38% |

*Dates of Frosts.*

| | |
|---|---|
| Last, | May 12 |
| First, | Sept. 25 |

*Dates of Snow.*

| | |
|---|---|
| Last, | April 8 |
| First, | Oct. 19 |

Twenty-eight halos were observed; 79 per cent were accompanied by storm within twenty-four hours, and 61 per cent within forty-eight hours after the occurrence of the halo.

The rainfall was a trifle above the average for fifty years, as recorded at Amherst College. The temperature was also above the mean for the same time.

C. D. Warner, *Meteorologist.*
A. T. Beals, *Assistant.*

* The first figures denote readings at top of tower, the second at base.

## Crops of the Year.

Of one hundred and six replies received from our crop correspondents, June 1, to the question, "Do you consider this season earlier than the average? If so, how much earlier?" forty-four stated the season to be about an average one, fifty-one that it was about a week earlier than the average, and eleven that it was from a week to ten days later.

To the question, "Is the outlook in your locality as favorable for farmers as it was ten years ago?" one hundred and eleven replies were received, of which forty-two stated the outlook to be as favorable, nine that it was more favorable, and sixty that it was not as favorable.

The first of July the stand of Indian corn was fairly good, and, though backward on account of unfavorable weather, was pushing rapidly ahead. In August it was growing finely, and promised to be a full average crop. October 1, seventy-one of the ninety correspondents replying to the question, "Do you consider the crop of Indian corn a full average?" stated that they did. The season was not particularly favorable to the growth and development of this crop, but, frost holding off until the 25th of September, opportunity was given for ripening, and most of it was cut and stooked in good condition.

According to the annual reports of the United States Department of Agriculture, the Indian corn industry in this Commonwealth may be represented by the following figures: —

| Year. | Acres. | Bushels. | Value. |
|---|---|---|---|
| 1870, . . . . | 40,212 | 1,327,000 | $1,300,460 |
| 1880, . . . . | 55,980 | 1,875,330 | 1,406,497 |
| 1885,* . . . . | 48,885¼ | 2,147,390 | 1,271,349 |
| 1890, . . . . | 54,134 | 1,868,000 | 1,307,336 |

* State Census.

Haying became general between the 20th and the 25th of June, although some orchard grass was cut the first week in

June. The hay crop proved to be unusually large in quantity, of fair average quality, and the weather for securing it was all that could be desired. Grass lands were somewhat injured by drought in the fore part of July, and rowen did not make a good start. The remainder of the season, and particularly September, being quite wet, rowen grew rapidly, and the crop proved to be nearly an average one. Much of it, however, was damaged by attempting to cure it during unfavorable weather.

An idea of the importance of the hay crop to our farmers may be gained from the following figures, taken from the annual reports of the United States Department of Agriculture : —

| Year. | Acres. | Tons. | Value. |
|---|---|---|---|
| 1870, . . . | 473,831 | 507,000 | $13,252,980 |
| 1880, . . . | 799,714 | 863,691 | 15,831,456 |
| 1885,* . . . | 618,709$\frac{5}{8}$ | 647,414$\frac{2}{3}$ | 9,676,893 |
| 1889, . . . | 642,252 | 674,365 | 10,621,249 |

* State Census.

July 1, potatoes, both early and late, promised uncommonly well. August 1, correspondents reported that rot had not appeared to any extent, and that the crop of early potatoes was an average one. On account of drought, late potatoes on light land ripened off when the tubers were only partly grown. September 1, on the whole, the crop promised to be nearly a fair average, and blight and rot were not very prevalent. The wet, muggy weather the first half of September, however, was very favorable to the development of this fungus, and, as a consequence, in many localities potatoes rotted badly both in the field and in the cellar. Many farmers, fearful of loss, forced their crop upon the market too early, depressing the price for the time being. The average price for the year has been higher than usual, and the total value of the crop will be fully equal to the average.

As illustrative of the importance of the potato crop in this State, the following figures, taken from the annual reports of the United States Department of Agriculture, are given : —

| Year. | Acres. | Bushels. | Value. |
|---|---|---|---|
| 1870, . . . | 25,090 | 2,208,000 | $2,119,680 |
| 1880, . . . | 41,620 | 5,244,120 | 2,674,501 |
| 1885,* . . . | 33,858⅜ | 3,584,505 | 1,904,225 |
| 1889, . . . | 35,964 | 3,632,000 | 1,997,800 |

* State Census.

The first of July the outlook for a crop of apples, both fall and winter, was very poor. There was a full bloom, but for some reason the apples had nearly all fallen off. The orchards that promised remunerative crops were the exception. On the whole, the yield of small fruits was fair, and the prices received were good. In most sections, however, dry weather shortened the yield very materially of all save strawberries.

The tobacco crop in the Connecticut valley was unusually large, of excellent quality, and mostly harvested in good condition ; but the wet, muggy weather in September caused pole-sweat to make its appearance in the sheds, and considerable damage resulted. The growers are receiving fairly remunerative prices for the crop.

Celery, cabbages, onions, turnips, rye and garden truck were generally satisfactory. Oats and beans were greatly injured by unfavorable weather.

Grape culture in this State has not increased to any extent in the past five years. This year's crop was a fair one. An article on "The Grape Industry in Massachusetts" will be found printed in this volume. An article will also be found upon "Lettuce and Cucumber Culture under Glass."

The cranberry crop was somewhat less than an average, owing to drought, fire worms, worm in the berry, hail and late frosts.

About the usual amount of fall seeding was done, and, as a rule, a good catch was secured. In reply to the question,

"Considered as a whole, has the season been a profitable one to the farmers in your neighborhood?" sixty-eight of our correspondents stated (November 1) that in their opinion it had, and twenty-four that it had not.

The following table will illustrate the price of certain farm products in Massachusetts, as compared with other States. The States for comparison are selected solely for their location: —

*Average Farm Price of Agricultural Products, Dec. 1, 1890. (United States Department of Agriculture, Report on the Crops of the Year.)*

| STATES. | Corn, per Bushel. | Wheat, per Bushel. | Rye, per Bushel. | Oats, per Bushel. | Barley, per Bushel. | Buckwheat, per Bushel. | Potatoes, per Bushel. | Leaf Tobacco, per Pound. | Hay, per Ton. |
|---|---|---|---|---|---|---|---|---|---|
| | Cents. | | Cents. | Cents. | Cents. | Cents. | Cents. | Cents. | |
| Massachusetts, | 70 | $1 15 | 81 | 55 | 77 | 65 | 84 | 15 | $13 50 |
| Virginia, | 55 | 96 | 67 | 45 | - | 65 | 67 | 8 | 10 70 |
| Louisiana, | 70 | - | - | 61 | - | - | 92 | - | 10 20 |
| Texas, | 72 | 95 | 80 | 55 | - | - | 90 | - | 9 50 |
| Ohio, | 51 | 91 | 63 | 42 | 70 | 65 | 85 | 7.5 | 7 50 |
| Illinois, | 43 | 87 | 59 | 41 | 60 | 62 | 95 | 7.6 | 7 60 |
| Kansas, | 51 | 77 | 55 | 38 | 57 | 75 | 98 | - | 5 18 |
| The Dakotas, | 50 | 70 | 47 | 32 | 52 | - | 68 | - | 4 50 |
| California, | 65 | 76 | 70 | 56 | 75 | 73 | 68 | - | 10 50 |
| General average of the United States and Territories, | 50.6 | 83.8 | 62.9 | 42.4 | 64.8 | 57.7 | 77.7 | 7.7 | $7 74 |

## The Dairy Industry.

An article on "The Dairy Industry in Massachusetts" was prepared for our crop bulletin for October, and will be found printed in this volume.

Believing that it would be of interest to the milk producers and consumers to know about what compensation the average producer of milk receives, the following questions were asked in our June circular to correspondents: "What was the price per quart received for milk at the door, in your locality, for May? Also, if furnished to milk contractors, what was the price received after surplus was deducted?"

The price received at the door, as given, varied from two to seven cents per quart. The following replies will illustrate the price received when the milk was shipped to contractors: —

*Barre.* — Sixteen cents per can at railroad station or factory. Some have to pay one cent for cartage, some two cents, according to distance.

*Belchertown.* — Five cents per quart to local customers. To milk contractors, delivered on cars, twenty cents per eight and one-half quart can.

*Berkley.* — Retail price at door, four cents per quart. Contractor's price, three cents for May. Now it is two and one-half cents.

*Bolton.* — Fifteen and seven-eighths cents per eight and one-half quart can to contractors, and five cents per quart if retailed in the villages.

*Danvers.* — Twenty-eight cents per eight and one-half quart can.

*Hardwick.* — All milk delivered at car; and, allowing one cent per can for delivery, and taking out the surplus from the eighteen cents, the price of a can of milk which holds eight and one-half quarts, we find that one of these cans brings the producer the whole amount of a fraction less than fourteen cents.

*Harvard.* — Graded price at depot, twenty cents per eight and one-half quart can for May; surplus taken out by contractors, two and one-quarter cents; cost of getting milk to depot, from one to three cents per can, according to distance. That would leave the milk producers about sixteen cents per can, on a fair average, or a trifle less than two cents per quart at the door.

*Leominster.* — Two and ten-seventeenths cents to peddlers for home use. To milk contractors, seventeen cents at door for eight and one-half quart can. The surplus for May not yet returned. Probably one and a half cents off per can, as in April.

*Littleton.* — The milk produced in this town is sold principally to contractors for the Boston market. The price at the door for May was two and three-tenths cents per quart for three-fourths of the quantity sold, and for the other one-fourth of the quantity sold, one and one-tenth cents per quart.

*Montague.* — Seventeen and eight-tenths cents per eight and one-half quart can.

*North Brookfield.* — Milk goes mostly to Boston. Will net in June about sixteen cents per can at car.

*Norfolk.* — Two and seven-tenths cents per quart at car. Price at door varies according to distance from station. No surplus.

*Westminster.* — Price of milk sold at the door is five cents per quart the year round. Contractors returned eighteen and one-half cents per can for May.

In our circular to correspondents for the October crop bulletin, the following questions relating to the dairy interest were asked: —

*First.* "Has the season been favorable for the production of milk and butter?" The correspondents were almost unanimous in stating that it had. The drouth from the middle of June to the middle of July materially checked the flow of milk, but, as the feed on the whole was unusually abundant, the total production of milk was above the average.

*Second.* "How have dairy products averaged in price as compared with former seasons?" Of the ninety-one replies to this question, forty-eight stated the price to have been about the same as in former seasons, thirty-three that it had been lower, and ten that it had been higher. It is thought that the price of milk has not materially differed from the average price in years past, but that the price of butter has averaged lower.

*Third.* "In your section, what is the chief disposition made of the dairy products produced?" It is a little difficult to condense the replies received to this question. Producers living near co-operative creameries generally send their cream to them, where it is made into butter. Others make butter on their own farms and sell in local markets, or, if they are fortunate enough to have a permanent city trade, dispose of their butter product in that way. The milk used in our cities is largely obtained from the Massachusetts farmer, and considerable is sent to Boston over the several railroads, where it is disposed of by milk contractors. Some of this milk comes to Boston from points more than one hundred miles westward. Other milk is retailed by the producer. Some is made into cheese, which is largely sold in Massachusetts markets.

*Fourth.* "Do you consider the business of dairying profitable to the farmers in your section?" The replies to this question covered quite a range of ground, but the central idea seemed to be that, if properly managed, dairying in this State is perhaps as profitable as any other branch of farming. It is not safe to say that those who are engaged in it are making much money. The farmer must have manure in order to grow crops, and he therefore cannot get along very well without keeping dairy animals.

*Fifth.* "What are the chief drawbacks, at present, to the carrying on of this industry?" The following were given as a

portion of the reasons why dairying is not more profitable to our farmers: high taxes; unscrupulous middlemen; over-production in summer, and shortage in winter; low prices of milk, butter and beef; cost of feed; competition of oleomargarine; abortion in cows; lack of good pasturage, and distance from market in some sections. The past year the scarcity of ice was a drawback.

A special circular was also sent to the treasurer of each of the then twenty-seven co-operative creameries in the State, and replies were received from eighteen of them. It appeared from the replies received that since April 1 last there was a slight increase in the amount of butter made; that the quality of the cream furnished was much the same as last year; that the prices received for butter averaged about one cent per pound less than last year; that the product sold as readily as last year; that most of the product was marketed in the State, although certain creameries sent more or less to New York, Brooklyn, Bridgeport, New Haven, Albany, Philadelphia and Providence; that it took from 6 to 6.53 spaces of cream to make a pound of butter; and that the creameries made a practice of coloring their butter a little, in order to have it uniform in appearance throughout the year. Some do not color from May 1 to November 1; others color a little nearly every month in the year. Most of the creameries reported that the market does not call for a highly colored product. Some of the creameries sell considerable unsalted and uncolored butter in New York markets.

The following were given as some of the drawbacks to the successful operation of co-operative creameries: Lack of capital to hold butter in summer; too much cream in summer, and too little in winter; cost of gathering the cream, on account of the distance necessary to be traveled; failure of patrons and creamery officers to co-operate heartily; under-selling by creameries, and want of unity as to selling-price of butter each month; competition of milk car; low prices received for butter; and lack of patronage caused by the hesitancy of farmers to join creamery associations.

The following table gives a list of the creameries in the State, date of their incorporation, and their work during the year 1890: —

## *Statistics of Creameries in Massachusetts for the Year 1890.*

| NAME. | Location. | Date of Incorporation. | Treasurer. | Pounds of Butter made. | Average Price Received per Pound. | Average Price per Pound net Realized by Patrons. | Number of Cows Supplying Cream. | Spaces of Cream Supplied. | Number of Patrons. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Cents. | Cents. | | | |
| Amherst Co-operative Creamery Association, The, | Amherst, | June 23, 1882, | William A. Magill, | – | 24.37 | – | [4]1,133 | – | [4]192 |
| Ashby Creamery Association, | Ashby, | – | F. W. Wright, | 34,461 | 23.50 | 19.50 | – | 218,517 | 28 |
| Ashfield Co-operative Creamery Association, The, | Ashfield, | Nov. 5, 1889, | Charles A. Hall, | [2]41,897 | – | [2]20.04 | – | [2]241,664 | 340 |
| Bay State Co-operative Creamery Association, The, | East Amherst, | Jan. 8, 1889, | C. E. Wakefield, | 99,838 | 26.00 | 23.00 | [1]760 | 611,230 | 76 |
| Belchertown Co-operative Creamery Association, | Belchertown, | Dec. 24, 1889, | – | – | – | – | – | – | – |
| Berkshire Creamery Co-operative Association, | New Boston, | Dec. 5, 1886, | O. B. Jones, | 86,608 | 25.22 | 18.65 | [1]450 | 569,074½ | 53 |
| Berkshire Hills Co-operative Creamery Association, | Monterey, | March 1, 1887, | – | – | – | – | – | – | – |
| Blackstone Valley Co-operative Creamery Company,* | Uxbridge, | Nov. 6, 1890, | C. A. Taft, | – | – | – | – | – | – |
| Chester Co-operative Creamery Association,* | Chester, | Feb. 27, 1891, | George Pease, | – | – | – | – | – | – |
| Conway Co-operative Creamery of Conway, | Conway, | May 25, 1886, | H. W. Billings, | 330,153 | 26.20 | 22.30 | 1,800 | 2,051,872 | – |
| Cummington Co-operative Creamery Association, The, | Cummington, | July 8, 1886, | R. R. Packard, | 174,294 | 23.34 | 20.00 | [1]850 | 1,077,147 | 113 |
| Egremont Co-operative Creamery Company, The, | North Egremont, | April 27, 1886, | J. A Kline, | 124,601 | 23.23 | 19.47 | [1]700 | 821,870 | 165 |
| Granby Co-operative Creamery Association, The, | Granby, | Jan. 21, 1889, | Frederick Taylor, | 71,336 | 25.60 | 20.20 | [1]330 | 439,905 | 36 |
| Hampton Co-operative Creamery Association, | Easthampton, | July 6, 1881, | J. A. Lyman, | 115,145 | 24.67 | 20.75 | – | 713,681 | 59 |
| Hinsdale Co-operative Creamery Association, | Hinsdale, | July 31, 1886, | F. B. Cook, | 118,112 | 23.48 | 18.24 | [1]800 | 772,055 | 75 |
| Ipswich Co-operative Creamery Company, The, | Ipswich, | April 24, 1885, | Curtis Damon, | 74,606 | 22.64 | 18.25 | 500 | 531,004 | 52 |
| Milford Creamery Company,* | Milford, | March 28, 1890, | – | – | – | – | – | – | – |
| Monson Co-operative Creamery Association,* | Monson, | Jan. 31, 1891, | C. C. Keep, | – | – | – | – | – | – |
| North Brookfield Co-operative Creamery Association, | North Brookfield, | March 17, 1885, | H. E. Cumming, | 87,632 | 25.50 | 20.41 | [1]475 | 576,054 | 45 |
| Northfield Co-operative Creamery Association, | Northfield, | April 16, 1885, | L. T. Webster, | 154,557 | 24.67 | 20.54 | 804 | 986,463 | 92 |
| Northampton Creamery Company Co-operative, | Northampton, | May 16, 1887, | – | – | – | – | – | – | – |
| Phillipston Co-operative Creamery Company, The, | Phillipston, | Feb. 24, 1888, | – | – | – | – | – | – | – |
| Plymouth County Co-operative Creamery Company, | Bridgewater, | Aug. 13, 1889, | Wales Hayward, | – | – | – | – | – | – |
| Rutland Co-operative Creamery Association, The, | Rutland, | April 16, 1886, | L. T. Hadley, | 95,350 | 25.09 | 20.08 | [1]650 | 658,486 | 62 |
| Shelburne Falls Co-operative Creamery Association, | Shelburne Falls, | Nov. 19, 1885, | G. W. Jenks, | 219,809 | [1]23.00 | 19.00 | – | 1,399,456 | 136 |
| Singletary Co-operative Creamery Association, The, | Millbury, | April 28, 1887, | C. N. Woodbury, | 40,199 | – | 21.29 | – | 260,287 | – |
| Springfield Mountains Co-operative Creamery Assoc'n, | Hampden, | Nov. 21, 1887, | C. H. Burleigh, | 64,159 | 24.70 | 18.87 | 275 | 392,224 | 40 |
| Wellesley Co-operative Creamery Association, | Wellesley Hills, | May 17, 1887, | Edward Lyon, | 14,527 | 28.20 | 22.50 | 125 | 125,657 | 20 |
| West Dudley Co-operative Creamery Association, | West Dudley, | Jan. 11, 1888, | H. W. Williams, | 49,852 | [1]26.16 | 19.16 | 230 | 319,249 | 30 |
| Worcester County, | Warren, | – | O. E. Parker, | 29,887 | 25 36 | 20.36 | [1]160 | 195,432 | 17 |

* Has not yet commenced business. [1] About. [2] From May 1 to January 1. [3] In December. [4] Census, November 5.

The Lowell Co-operative Milk Association, the Springfield Co-operative Milk Association and the Wachusett Milk Company of Worcester, make quite a large quantity of butter from their surplus milk. The same is also true of the milk contractors. The Springfield Co-operative Milk Association report that they will, the present year, reach nearly 2,500,000 quarts in receipts of milk. All milk not sold is separated, and the cream churned. In 1890, 115,000 pounds of butter were made, selling at an average price of twenty-seven cents per pound. The average price received per pound by the Lowell Co-operative Milk Association, for the year, was thirty-four cents.

## Insects.

The tent caterpillar (*Clisiocampa Americana*) was unusually numerous during the month of May; and in the May crop report it was suggested, as the wild cherry trees along the roadsides are breeding-places of this pest, that the granges and farmers' clubs take steps to lessen the number of these trees along our country roads.

The Colorado potato beetle was not as prevalent as usual. The various other destructive insects, as the currant worm, asparagus beetle, canker worm, codling moth, curculio, rose bug, cut worm, squash bug, cranberry-vine worm, onion maggot, peach borer, and the others that infest and destroy our crops, were on hand in their season, and did the usual amount of damage.

## Gypsy Moth.

In my last report the hope was expressed that the Legislature would deal wisely and liberally with this new problem. It is of supreme interest to all agriculturists, but it is also of interest to every dweller in city or country; for this creature feeds upon the foliage of almost all our deciduous trees and shrubs, as well as upon the crops of the farm. Its power of multiplication seems almost without limit. If it cannot be entirely stamped out, it will be forever a menace not only to the crops and trees of our State, but to those of the whole continent. Its spread over the land is only a question of time. Our Legislature of last year made liberal provision for a campaign of extermination by an appropriation of $50,000, and provision for a commission to take

charge of the work. Much work has been done and much good accomplished by the commission. The habits of the creature have been observed, and millions of them destroyed. It is believed that they have been prevented from spreading over new territory, and thus with the experience of the last season the operations of the coming spring and summer will be much more successful. The liberal appropriation by the last Legislature was only about one-half expended, leaving what would seem to be sufficient funds to carry on effective work throughout the coming season. A report has been made by the commission to the Governor and Council, but it has not yet been printed. I desire to again record my sense of the importance of earnest work by those in charge of the matter. Scientists all agree in believing that, if it is possible to extirpate the pest, it should be done, let the expense be what it may. It will be a disgrace to the Commonwealth that thirty years ago stamped out pleuro-pneumonia, which had gained a lodgment within her boundaries, if she fails to eradicate this pest.

## Trespassing.

Desiring to ascertain to what extent our farmers are troubled by trespassers, the following question was asked in our circular to correspondents in July : "Are farmers in your vicinity troubled to any extent by parties trespassing upon their farms, or stealing their products?" One hundred and seven replies were received, of which fifty-five answered "Yes" and fifty-two "No."

In order to show in what sections of the State this trouble existed to the greatest extent, as indicated by the replies, the following table was prepared : —

| COUNTIES. | No. of Replies. | Yes. | No. | COUNTIES. | No. of Replies. | Yes. | No. |
|---|---|---|---|---|---|---|---|
| Barnstable, . . | 4 | 1 | 3 | Middlesex, . . | 12 | 3 | 9 |
| Berkshire, . . | 9 | 2 | 7 | Nantucket, . . | – | – | – |
| Bristol, . . | 6 | 3 | 3 | Norfolk, . . | 4 | 3 | 1 |
| Dukes, . . | 1 | – | 1 | Plymouth, . . | 8 | 3 | 5 |
| Essex, . . | 9 | 5 | 4 | Suffolk, . . | – | – | – |
| Franklin, . . | 14 | 10 | 4 | Worcester, . . | 20 | 13 | 7 |
| Hampden, . . | 12 | 7 | 5 | | | | |
| Hampshire, . . | 8 | 5 | 3 | Totals, . . | 107 | 55 | 52 |

Because of the general complaint of trespassing made by our correspondents, and the possible ignorance of some as to the provisions of law in regard to trespass, it was thought best to print in this bulletin the trespass laws as they then stood on our statutes. We have a few of these copies left, and will mail them to those who want them.

### Agricultural Societies.

The incorporated agricultural societies represented on the Board are most of them in a prosperous condition, as will be seen by a reference to their financial returns printed in this volume. The exhibitions of farm stock, field, garden and dairy products at the fairs of these societies have been larger and of better quality than usual. In some cases the improvement has been marked. The attendance, except in a few cases where stormy weather prevented, has been larger than in previous years. The criticism is often made that these fairs are largely opportunities for recreation and amusement, and that the State is furnishing money for these purposes by the bounty it pays yearly to the societies. But it should be remembered that the amount of bounty paid to each society is predicated upon the amount of premiums paid for agricultural purposes at the fair of the preceding year, and that none of the bounty of the State is expended for horse racing or for other amusements, or even for the running expenses of the societies. Two new societies, besides the Worcester East alluded to in my last report, will this year become eligible to the bounty of the State, and have chosen members of the State Board of Agriculture. The Weymouth Agricultural and Industrial Society, located at South Weymouth, was made eligible by an act of the Legislature amending the general law, and the Attleborough Agricultural Association, incorporated in 1887, by complying with the requirements of law and the regulations of the Board of Agriculture.

The circular for the financial returns of the several societies was materially changed before being sent to the several treasurers for the annual return required to be filed in this office on or before the tenth day of December. It was required in this circular that the value returned for the

several kinds of property be the estimated market value. It will be readily understood that the real estate belonging to societies located in the rural districts of the Commonwealth is nót worth as much now, as a rule, as it cost when purchased by the societies many years ago, while it may be worth just as much, if not more, for society purposes. In other sections the market value of the property of the societies has greatly increased, while perhaps it is worth no more than formerly for society purposes. Heretofore these financial returns have not been made in a uniform manner by the societies, and in some cases the value returned has been, not the present market value, but the total cost of the land, buildings, etc. It should be remembered, therefore, that the tables presented this year show more nearly than heretofore the exact financial condition of the several societies.

The following table is appended for comparison of the financial returns of the societies for the years 1860 and 1890: —

| | 1860. | 1890. |
|---|---|---|
| Number of societies, | 25 | 36 |
| Bounty paid to societies, | $13,196 95 | $19,623 62 |
| Receipts for the year, | 65,609 03 | 193,684 29 |
| Premiums and gratuities paid, | 13,323 03 | 55,112 40 |
| Disbursements for the year, | 55,389 17 | 183,707 89 |
| Indebtedness, | 41,370 38 | 163,278 29 |
| Total liabilities reported, | 41,370 38 | 169,430 85 |
| Value of real estate, | 153,001 21 | *729,519 66 |
| Value of personal property, | 67,604 76 | *52,259 81 |
| Permanent fund, | 197,212 20 | 772,993 43 |
| Total assets reported, | 220,605 97 | 803,806 80 |
| Amount of premiums paid for live stock, | 9,114 87 | 20,804 86 |
| Amount of premiums paid for farm products, | 3,193 94 | 10,280 47 |
| Number of persons who received premiums and gratuities, | 4,338 | 9,426 |

* Estimated market value.

The following statement, of the amounts of money appropriated and used for the furtherance of the agricultural interests of the Commonwealth through the medium of this department, will no doubt be of interest: —

| OBJECT FOR WHICH APPROPRIATED. | 1888. | | 1889. | | 1890. | | 1891. |
|---|---|---|---|---|---|---|---|
| | Appropriated. | Used. | Appropriated. | Used. | Appropriated. | Used. | Appropriated. |
| Bounties to societies, . . | $19,200 00 | $18,367 85 | $19,800 00 | $19,396 30 | $20,400 00 | $19,623 62 | $21,000 00 |
| Traveling and necessary expenses of the Board, . . | 1,600 00 | 1,362 92 | 1,900 00 | 1,374 72 | 1,900 00 | 1,615 32 | 1,900 00 |
| Traveling and necessary expenses of the secretary, . | 350 00 | 350 00 | 500 00 | 500 00 | 500 00 | 500 00 | 500 00 |
| Incidentals, office of secretary, . . | 566 91 | 566 91 | 500 00 | 500 00 | 500 00 | 500 00 | 500 00 |
| Salaries of secretary and clerk, . . | 3,700 00 | 3,700 00 | 3,700 00 | 3,700 00 | 3,700 00 | 3,700 00 | 3,700 00 |
| Dissemination of useful information in agriculture by means of lectures or otherwise, . . | 1,800 00 | 1,659 82 | 2,000 00 | 1,997 42 | 2,200 00 | 2,198 69 | 2,200 00 |
| Printing 15,000 copies of the "Agriculture of Massachusetts," . . | 5,521 08 | 5,521 08 | 7,305 00 | 7,305 00 | 6,729 37 | 6,729 37 | *7,000 00 |
| Totals, . | $32,737 99 | $31,528 58 | $35,705 00 | $34,773 44 | $35,929 37 | $34,867 00 | $36,800 00 |

* Estimated.

## Legislation.

The legislation of the year 1890 that had particular reference to the agricultural societies was an amendment to section 1 of chapter 114 of the Public Statutes, authorizing the payment of a bounty to certain agricultural societies (Acts of 1890, chapter 297); an act stating the conditions under which societies may sell or mortgage the whole or any portion of their real estate (Acts of 1890, chapter 274); an act to incorporate the Worcester East Agricultural Society (Acts of 1890, chapter 41); an act to authorize the Union Agricultural and Horticultural Society established in the town of Blandford to take land for agricultural purposes (Acts of 1890, chapter 411); and a resolve in favor of the Worcester East Agricultural Society, providing for the payment of two hundred dollars bounty (Resolves of 1890, chapter 36).

At the annual meeting of the Board, Feb. 3, 4 and 5, 1891, the following regulations were adopted : —

1. That the agricultural societies be required to print a revised list of their members in their transactions for 1891, unless such list has been printed in their transactions within three years.

2 That the societies be required to print in their transactions the names of the officers for each year ensuing their election.

3 That amounts paid in premiums to parties not residents of this State shall not be considered in predicating the amount of State bounty the societies shall receive.

4. That the secretary be instructed to notify the societies that they will be required to make their returns in strict compliance with the provisions of law and the regulations of the Board.

## Farmers' Institutes.

The regulations of the State Board require each of the thirty-eight societies which expect the State bounty to hold not less than three farmers' institutes each year. Some societies hold more than the required number. These institutes have been mostly well attended. Live topics have been treated by lectures, which were followed by interesting discussion, in many cases awakening much enthusiasm. It is believed that much valuable information has been imparted, and that the agriculturists of the State are as a whole fairly prosperous. The "old paths" so often recommended do not get praise in the farmers' institute of to-day. Changed conditions require a change in practice. Our fathers prospered by producing staple farm products. The wonderful transportation facilities of to-day enable all parts of the world to send such products to us at small expense, and Massachusetts farmers must compete on almost even terms with the mellow and fertile soil of the Western prairies. But Massachusetts has a full hundred of cities or towns that have more than four thousand inhabitants. Most of the people who live in these centres enjoy a liberal income or earn good wages, and they are willing to spend that income for the good things of life. They want the luxuries of life, — the finest butter, the purest milk, the freshest of poultry products, the products of gardens and greenhouses in season

and out of season. They are willing to pay for them. He who furnishes what is wanted and just when it is wanted, gets a good price and makes a profit. Here lies the opportunity of the Massachusetts farmer. The effort at the institutes has been to stimulate enterprise in these directions. The agricultural productions of the State are increasing in value from year to year. The loss in beef, wool, wheat, etc., is more than made up by an increase in milk, butter and fine fruits, including cranberries and garden products.

### Abandoned Farms.

Meantime, we hear much of the abandoned farms in the State. They are in retired locations, mostly among the hills. Some of them are ideal situations for summer residences of the well-to-do, others are adapted to specialties in agriculture. This office is in continual receipt of letters of inquiry about such property. If the Legislature would provide for an official list and descriptions of such property, somewhat after the plan pursued in New Hampshire, it is believed that many of these farms might be sold, and thus become productive property, enhancing the valuation of the State and adding to its production and population.

### Meetings of the Board.

The public winter meeting of the Board at Worcester, December 2, 3 and 4, was a success in the quality of the lectures presented. The policy of procuring for this meeting men of national reputation as agricultural lecturers, gave us an exceedingly interesting programme. The audiences were not large, but the prominent farmers were present from all over the State, and the discussions that followed the lectures were animated, and questions on practical points of the addresses brought out a vast amount of valuable information. The essays at the annual meeting by members of the Board are worthy of a place with the lectures at the Worcester meeting. This matter printed in this volume, "Agriculture of Massachusetts, 1890," will be a standard for reference in the institutes of the coming year, and in the discussions of our granges and farmers' clubs.

## Distribution of the Annual Report.

The liberality of our Legislature provides for the printing of 15,000 copies of the "Agriculture of Massachusetts," and the distribution of them is such that every city and town in the Commonwealth shares in it. The distribution of a little more than half is provided for by law, each member of the Legislature having twenty-five copies, and five hundred copies are bound with the public documents.

The remainder are distributed through this office to members of the Board of Agriculture, members of agricultural societies, farmers' clubs and granges and to farmers in towns having no member of the Legislature or of the Board, or no agricultural organization, through our appointed agents, and a few are retained in the office to supply those who are not able to get them from the sources above mentioned.

Frequent requests come to this office for back volumes of the "Agriculture of Massachusetts." Much difficulty has been experienced in the past in supplying these; and, in order that we might not be obliged to refuse such requests, the policy has been adopted of purchasing these volumes from parties having them for sale, whenever it could be done advantageously; and thus parties desiring these reports have been able to procure them for what they cost us. This results in good in two ways. It prevents the books from being destroyed, and also enables parties wishing to do so to complete their sets at a comparatively small expense.

The following is given as an illustration of what has been done in this line the past three years: —

Massachusetts Agricultural Experiment Station, 20 vols.; Utah Agricultural Experiment Station, 18 vols.; Georgia Agricultural Experiment Station, 16 vols.; Rhode Island Agricultural Experiment Station, 26 vols.; Portuguese government, 36 vols.; Utah Agricultural College, 7 vols.; Chicago Public Library, 13 vols.; Cornell University, 11 vols.; Wellesley College, 8 vols.; University of Illinois, 17 vols.; German Consul, Boston, 29 vols.; University of Minnesota, 30 vols.; Cleveland, O., Public Library, 25 vols.; New Hampshire Agricultural Experiment Station, 28 vols.; Astor Library, New York, 4 vols.; Harvard Univer-

sity, 6 vols.; United States Department of Agriculture, 6 vols.; Dayton, O., Public Library, 3 vols.; Patent Office Library, London, 3 vols.; Cumberland Grange Library, Abbott Run, R. I., 13 vols.; New York Agricultural Experiment Station, 7 vols.; Purdue University Agricultural Experiment Station, 7 vols.; Agricultural College, Sapporo, Japan, 15 vols.; Storrs Agricultural School, 9 vols.; Raymond Library, East Hartford, Conn., 19 vols.; New York State Agricultural Society, 7 vols.; Juvenile Asylum and Farm School, Hartford, Conn., 18 vols.

## Library.

During the past year quite a number of recent works on agriculture and kindred subjects, and works of reference, have been added to the office library; also a number of the annual reports or transactions of societies, experiment station bulletins and other pamphlets, have been bound and placed on the shelves for preservation and in a convenient form for future reference.

An effort has been made to complete the files of the transactions or annual reports of the several societies which are now or have been represented on the Board of Agriculture. The files of several societies have been made complete. The copies named below are lacking, and it is hoped that the officers of the several societies or others will assist in completing the files that are now incomplete. There are a number of duplicates in the office, which will be sent to societies wishing them.

*Barnstable County.* — 1873 and all previous to 1872.

*Berkshire County.* — 1869, 1870, 1877, 1882, and all previous to 1868 save 1859.

*Bristol County.* — 1855, 1857, 1858, 1860, 1861, 1877, 1883, and all previous to 1854.

*Eastern Hampden.* — First six annual reports, 9th, 10th, 11th, 14th, 27th.

*Franklin County.* — 1st, 2d, 10th to 16th inclusive, 21st.

*Hampden.* — 1860, 1861, 1862, 1864, and all previous to 1859.

*Hampshire.* — 1850, 1852, 1854 to 1859 inclusive, 1861 to 1864 inclusive, 1866, 1867.

*Hampshire, Franklin and Hampden.* — First 43 annual reports, 47th, 50th, 51st, 52d, 53d.

*Highland.* — 1871, and all previous to 1867.

*Hoosac Valley.* — First 5 annual reports, 7th annual report, 1866.

*Housatonic.* — 1866, and all previous to 1865.

*Marshfield.* — 1867, 1870.

*Martha's Vineyard.* — All previous to 1866.

*Middlesex.* — 1858, 1873, 1876, 1877, 1879, and all previous to 1854.

*Middlesex North.* — 1857, 1862, 1874.

*Middlesex South.* — 1857, 1858, 1859, 1861, 1877, 1884.

*Nantucket.* — 1857, 1863, 1869, 1870, 1871.

*Plymouth County.* — 1854, 1856, 1858 to 1860 inclusive, 1862, 1865, and all previous to 1853.

*Union.* — 1873, 1876 to 1880 inclusive.

*Worcester.* — 1827 to 1830 inclusive, 1832 to 1842 inclusive, 1860 to 1867 inclusive, 1878 to 1882 inclusive.

*Worcester North.* — 11th annual report, 1863.

*Worcester South.* — 1862 to 1866 inclusive, 1870, and all previous to 1861.

*Worcester County West.* — All previous to 1867.

We also lack the transactions of the old Bristol County Central Society for the year 1871, and any since 1876; and of the old Worcester South East Society the 3d, 4th and 5th annual reports, and the 8th annual report, 1867.

A Board of forty-five members is a large one for effective work, but, by the appointment of delegates to visit the several societies, an examining committee of the Agricultural College, a committee on legislation and an executive committee to act for the Board in emergencies, and the secretary and his clerk in constant attendance in this office, the duties of the Board are well attended to. The members are as a whole painstaking, and willing to spend time and talents for the promotion of the agricultural interests of the State. During the past year one of the oldest and most honored members of the Board, Hon. Velorous Taft of West Upton, has been removed by death. His long connection with the Board, and his large and varied experience in public positions, made his counsels valuable to all the members. Resolutions of respect to his memory will be

found in the records of the annual meeting printed in this volume.

The House of Representatives of 1890 called on the Board of Agriculture to investigate and report upon the need of legislation in regard to the forests of the State, and also upon the birds of Massachusetts, both useful and injurious to agriculture. This duty has been performed, and these reports will be found printed in this volume.

WM. R. SESSIONS,

*Secretary of the State Board of Agriculture.*

BOSTON, February, 1891.

# PUBLIC MEETING OF THE BOARD

AT

# WORCESTER.

DECEMBER 2, 3 and 4, 1890.

# PUBLIC MEETING OF THE BOARD
## AT WORCESTER.

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The regular winter meeting of the Massachusetts Board of Agriculture was held at Horticultural Hall, in Worcester, on Tuesday, Wednesday and Thursday, Dec. 2, 3 and 4, 1890. The attendance at the opening session, although not large, was quite respectable in point of numbers, and the interest manifested in the lecture and the discussions which followed was of the most gratifying character, and was well maintained during all the sessions.

The meeting was called to order at ten o'clock on Tuesday, December 2, by Secretary Sessions, who introduced as the chairman for the day Mr. C. L. HARTSHORN of Worcester, representing the Worcester Agricultural Society on the Board.

Mr. HARTSHORN said: —

GENTLEMEN OF THE STATE BOARD:— It gives me great pleasure to welcome you here in the city of Worcester. It was fourteen years ago that you held your last meeting with us. At that time the gentleman who presided told you that he represented a city of about fifty thousand inhabitants; to-day we have about eighty-five thousand population. Our increase in agriculture, in manufactures and in other directions, will be spoken of by others who are here to-day to welcome you. I have at this time the pleasure of introducing to you His Honor Mayor FRANCIS A. HARRINGTON of Worcester.

### ADDRESS OF MAYOR HARRINGTON.

MR. PRESIDENT AND GENTLEMEN OF THE STATE BOARD OF AGRICULTURE: — It is certainly a pleasure to me, as representing the city, to greet you and to welcome you to Worcester. Agriculture was the first, and still is the prom-

inent, occupation of man. The soil on which we live is the great store-house of wealth, from which we draw it freely and which contributes so largely to supply the wants of man. Gladly, then, do we welcome to our city the representatives of the agricultural interests, especially when we consider the farming resources of our county. We believe here in Worcester in the farms and in the men who come from them to aid us in building up our city and our State. We know the sterling character of the Massachusetts farmers; and, gathered here as you are, to consider questions relating to their welfare, I am glad of the opportunity to welcome you to Worcester. I trust and hope that your meeting will be a pleasant and valuable one, and that the influence that shall go forth from the papers and discussions will be not only of value to the farming community, but to all the citizens in our city and throughout our State.

The CHAIRMAN. The State Board is here to-day by invitation of the Worcester Agricultural Society. The president of that society will now extend to you a welcome in its behalf. I have the pleasure of introducing Mr. J. LEWIS ELLSWORTH.

## OPENING ADDRESS.

BY J. LEWIS ELLSWORTH OF WORCESTER.

MR. CHAIRMAN AND GENTLEMEN OF THE STATE BOARD OF AGRICULTURE: — As president of the Worcester Agricultural Society, at whose invitation you have honored us, it is my pleasant duty to extend you a cordial welcome in their behalf, to the city of Worcester. Twenty-five years ago this Board held the third of these meetings here, and fourteen years ago we were favored again. These two meetings left us with a better knowledge of the principles of cultivating the soil and conducting farming operations. The persons who represented you and the advice given have not been forgotten by the farmers of these hill-sides in Worcester and the adjoining towns.

It is customary, upon opening these meetings, to give a brief sketch of the city or town where the meeting is held, that those who attend may be better acquainted with the place and with the industries of the people who reside there.

We are proud of our city, — of its well-kept highways leading to the fertile farms upon the outskirts. No city could ask for more attractive pleasure drives than lead from Worcester in all directions, down to the beautiful Lake Quinsigamond on the east, or among the farms on the west. In these drives the thrift of the farming population is very noticeable in well-painted buildings and close-cut lawns, ornamented by shrubs and flowers. The roadsides are shaded by rows of trees set out by private individuals or the park commission. Upon Arbor Day certain varieties of shade trees are given by the park commission to those who will take the trouble to set them out by the roadside. Many have availed themselves of this opportunity, and in a few years hence we shall see the beautiful results. Nature has been very lavish in her gifts to Worcester. The well-rounded hills, green to their summits, combine with the fertile valleys in one beautiful landscape.

Worcester was settled in 1664, by half a dozen families from Sudbury, Watertown and Charlestown, and was first called Quinsigamond, from the name of a tribe of Indians located here. The fertile country around Worcester attracted the attention of the first settlers. They were interested in the development of the country, and to gain neighbors they petitioned the Great and General Court to have a committee appointed to make surveys, investigate the country, and report their findings. The committee was appointed in 1665. In 1667 they reported that they had viewed the location, and found it twelve miles from Marlborough on the road to Springfield, about half-way between Springfield and Boston, and that it was a tract of very good chestnut-tree land, of meadow not so much. However, they reported in favor of a small plantation or town of thirty families; or, if it was to include the territory which had previously been granted to others, it would in their estimation support sixty families. Now, after the lapse of more than two centuries, as we look upon these hills and valleys of that very good chestnut-tree land, thickly dotted with homes of the people engaged in many trades and professions, and supporting a dense population, the low estimate of the capacity of the tract of land, which might possibly support

sixty families, furnishes strong contrast between their humble anticipations and our now overflowing prosperity. Worcester was incorporated a town in 1722 and a city in 1848. Within the memory of some of its citizens, Worcester has grown from a little farming village to a manufacturing and commercial city, with a population of 85,000, and with an assessed valuation of $69,403,251. There is annually appropriated $1,178,221 to defray the expense of maintaining and extending the public institutions, for schools, the public library, highways, sewers, water and fire departments, and to provide police protection.

There are two hundred and ten miles of streets; six miles of these are paved, and thirty miles macadamized. We have one hundred and fourteen miles of water pipes, and seventy-one miles of sewers.

The educational institutions of the city constitute a feature in which the inhabitants feel a commendable pride. There are in its public schools 12,175 pupils, and the average annual expense of these schools amounts to $252,669, a sum exceeding that expended in any other municipal department. The value of the school buildings and their equipments is $1,200,000. Worcester contains within its borders Clark University, a princely and munificent gift of one of its many open-handed citizens. Again, it has the College of the Holy Cross, and the Polytechnic Institute for free education in scientific and mechanical pursuits. This is one of our most useful institutions, as it yearly sends out young men with an education practical and thorough. It was founded by Mr. Boynton, and has been since assisted by the late I. Washburn and Mr. Stephen Salisbury. There is also the State Normal School, the Worcester Academy and the Highland Military Academy.

Another public measure in which Worcester takes an especial pride is its system of public parks. These are so arranged as to form a chain or garland round about the city, and afford to each section of the city its own breathing-place. There are eleven of these, and they contain an aggregate of three hundred and sixty-two acres. Of this number, all but two have been acquired by purchase or have been the gift of public-spirited citizens within the past five years. The work

of developing these tracts is progressing under the skilled and intelligent direction of the park commission, and already several have been transformed into beautiful resorts, where rich and poor alike may enjoy the pure air and see the beauties of nature without trespassing on private grounds.

Connected with the sewer department is the purification plant. The people living along the Blackstone River, into which the city sewage empties, appealed to the Legislature to compel the city to purify the sewage before allowing it to enter the river. Accordingly our engineer was sent abroad to investigate the matter. After considering different methods, he finally recommended chemical precipitation. The works are now complete and in operation. From three to four million gallons of sewage are daily successfully treated, and the dirty water is changed into clear, bright, and to all appearance pure, water. Worcester has the only large plant of the kind in the country. Lime is the principal chemical used. When this is first applied, the water becomes inky black, but as it passes on from tank to tank, six in number, the foul matter settles, until in the last the water flows away perfectly clear.

Worcester owes its phenomenal growth to its varied manufacturing interests, which require all grades of laborers, from the most highly skilled down to the least. The population is continually on the increase, for there is always a demand for labor in one branch of business or another. Among the largest manufactories are the Washburn & Moen Company, employing 3,500 men, and making all grades of wire; the Crompton & Knowles Loom Works, and the Whittall Carpet Factory. There are also manufactories where envelopes, iron and wood working machinery, fire-arms, water meters, cutlery, ice and roller skates, and many other articles of merchandise, are made. Agricultural implements are also manufactured to a great extent. One firm alone, the Ames Plow Company, manufactures nearly every kind of tool used on the farm. This house has sent out 225 different kinds of plows within the past forty years. Another firm, the Richardson Manufacturing Company, has sent out this year 7,000 mowing machines, 3,000 hay tedders, and 1,000 manure spreaders. It is estimated that

the sales of the several manufacturing industries of Worcester amounted to about $40,000,000 the past year.

Worcester leads as an agricultural city also. There are 23,040 acres of land in the city, and of these 18,249 are devoted to agriculture. This land is divided into 349 farms, and, according to the census of 1885, the products of these farms were valued at $620,756. Market gardening is carried on to a considerable extent, and is on the increase, as the growth of the city creates a greater demand; but the chief source of income is from the dairy. No cheese is manufactured, and but little butter. Most of the milk is sent direct from the dairy to the city, and there delivered to families; but a considerable amount is sold at wholesale. The standard price of milk at retail is six cents per quart during the winter months, and five cents during the summer. Stock raising is carried on only to a very limited extent, farmers preferring to supply their dairies by purchasing cows. By the census from which I have already quoted, the value of the dairy products produced was $209,336; hay, $148,061; vegetables, $74,374; fruit, $29,314; poultry and eggs, $20,990.

The Worcester Agricultural Society, one of the oldest in the State, and for many years the only agricultural society in the county, was incorporated Feb. 23, 1818, having for its object the promotion of agriculture. The first president was the late Levi Lincoln, and the first vice-president the late Daniel Waldo. The first exhibition was held in October, 1818, on the open space where the city hall now stands. The exhibitions were held in the same place until 1852, when the society departed from its customary order of holding cattle-shows on public grounds, and purchased land for the purpose. The first parcel purchased contained six and one-half acres, and cost the society $2,765. This was the nucleus of the valuable tract now owned by the society, about one-half mile west of Main Street. The present grounds contain twenty-four acres, with a half-mile track, in fine repair; a grand stand three hundred feet long; two large exhibition buildings; sheds for cattle, sheep and swine, and closed stables for horses. The property of the society is valued at $125,000. The grounds are compact, and

during the annual fairs are crowded with interested people. This society has for a number of years past held a joint exhibition in connection with the New England Agricultural Society, thus enlarging its premiums and drawing out the very best of farm products. The yearly expenses of the society are about $25,000, including $13,000 paid out in premiums. The gross income is about $30,000. The premiums are distributed in sums calculated to bring out the best cattle, horses, sheep, swine, and farm and dairy produce in New England. The society has about 1,700 members. Lawyers, doctors and farmers are equally interested in the welfare of the society. Among the early presidents were the late Governors Lincoln and Bullock, Daniel Waldo, Isaac Davis and Wm. S. Lincoln. Most of the leading citizens are on the list of members.

The Worcester County Horticultural Society is closely allied to the Agricultural Society, although it confines its attention to floriculture and horticulture. It was organized Sept. 19, 1840, with the late Dr. John Green as president, and Wm. Lincoln as secretary. The society was incorporated in 1842, and has had a long and brilliant career. The first exhibition was in the town hall, and the society continued to hold its meetings in various halls until 1852, when it purchased the land this building stands on. The rise in value of this property has made the society financially independent. It yields a handsome income, which is expended in premiums and in making additions to its valuable library.

The Worcester Grange was organized in 1873. It has 267 members, being the largest grange in the State. This organization began in a very modest and quiet way, in the library of this hall. As its membership increased, it removed to larger and still larger rooms, until this year, when the hall it had been occupying was to be remodeled, the Grange took the lease and fitted it up for its use in a tasteful and suitable manner. Just how much benefit these societies have been to the farmers of this vicinity, it is impossible to tell; but it is certain that a change for the better is indicated by improved stock, better cultivation, and by the evidences of comfort and refinement that mark the home of the farmer of to-day.

Mr. Chairman and gentlemen of the State Board of Agriculture, may your stay here be both profitable and pleasant. I assure you the members of the Worcester Agricultural Society appreciate your labors, and the earnestness manifest on every hand for the advancement of the cause which you represent. If you should desire to visit some of our farms, factories, city departments or educational institutions during your stay in our city, we shall be pleased to afford you every facility for doing so.

The CHAIRMAN. There is a question box here, and any gentleman who has a question that he wishes answered by the members of the State Board, or any one present, will please deposit it in the box, and from time to time as opportunity occurs during our sessions the questions will be drawn out and answered as well as they can be by some one in the audience. The secretary, Mr. SESSIONS, will have charge of the box, and any question handed to him will be placed in it.

The first topic on our programme has reference to experiment stations. They are comparatively new here in New England, and the question arises, What have they done for the farmer? We have with us to-day Prof. G. H. WHITCHER, Director of the Agricultural Experiment Station at Hanover, N. H., who will now speak to us upon this subject.

## WHAT HAVE OUR EXPERIMENT STATIONS DONE FOR THE FARMERS?

BY PROF. G. H. WHITCHER.

MR. PRESIDENT AND GENTLEMEN: — I propose to consider the subject of experiment stations under three heads: —

1. Why do we have experiment stations?
2. How shall we measure their value?
3. What have they accomplished?

In any industry, it matters not what that industry is, there are constantly arising obstacles which stand in the way of perfect success, and it becomes necessary to overcome these obstacles in order that the best results may be obtained. Take, for example, some of the common industries that we have seen springing up and developing into vast proportions

in recent years. I have thought several times of one illustration which I will bring up here to-day, and that is in connection with the Edison incandescent electric light. That has nothing to do with experiment stations; it will, however, show the principle that is involved. Edison gave to the world that form of electric light known as the incandescent light. He was puzzled to find something to take the place of platinum for the filament, the particles of which become white-hot and give out light without becoming fused. He saw that platinum was too expensive, and at once set to work to find some cheap substitute. It must be cheap, and it must have certain characteristics and qualities. Now, Edison knows no such thing as failure; that word is not in his vocabulary. He knew that carbon had certain properties which would fulfil all the requirements, but it must be a certain form of carbon, and must be very tough, not easily broken by the shocks and jars to which these lights are subjected. After a very long series of experiments, which he kept up day and night (it is said that he had only four hours' sleep while he was conducting these experiments), he found that the fibre of bamboo carbonized would serve his purpose, and we have to-day the incandescent electric light in which those fibres of bamboo are used. There is a fact in connection with this matter which always struck me as interesting and remarkable, and that is, that Edison made a contract to furnish incandescent electric lights at the cost of twenty-five cents each for these little bulbs, when at that very time he was paying five dollars for every one of them that he received. Now, to some this may have seemed very foolish on his part, to assume that they could be manufactured at that price; and yet, with that clear insight which characterizes this wonderful man, he saw, first, that there would be a great demand for the lights, and therefore they could be manufactured cheaply; and, secondly, he saw that new processes, new apparatus, etc., would be invented when this demand was appreciated, which would enable manufacturers to give them to the world at the very small price which he put upon them, and the result has justified his faith.

This is merely an illustration. It brings out this one point, — that progress means the overcoming of obstacles,

and the overcoming of obstacles can only be brought about by invention, investigation and discovery.

Now, if we turn from manufactures, where many other specific illustrations might be brought up, to the agricultural industry, we shall find that that occupation is no exception to the general rule; that, if we are to have progress, we must overcome the difficulties and obstacles which have stood in the way of the development of that industry in the past.

For the purpose of bringing out a little more clearly the history of agriculture, I have been accustomed to divide it into three periods, which we may consider as tolerably well marked. Not that we can definitely fix upon any one year as marking the dividing line between one period and another, but each of these three periods has peculiar characteristics which distinguish it from the others. The first covers the period of original soil fertility; the second is the period of soil exhaustion; the third is the period of renovation.

Now, in each of these there are a number of things to be considered. First, take the period of original soil fertility. In the history of any agricultural country there is a time, before the soil becomes impoverished, when the accumulations of plant food that have been stored up in the ground for ages appear to be inexhaustible, and no system of agriculture is required to secure abundant crops. The soil has only, as it has been said, to be "tickled with a stick, and it will laugh in a harvest." What is the result of this condition of things? It is that the systems of agriculture, or rather the methods of agriculture (there is no system), are very crude, very wasteful. What was the use of being careful to store plant food in the soil, so long as it was considered inexhaustible? There is the great fallacy that has existed during the period of original soil fertility in all countries, and this country is no exception. Every country has passed through this same period, when the idea has prevailed that the fertility of the soil was inexhaustible; that is, that the soil is full of plant food, that it can never be materially diminished, and all that the farmer has to do is to plough, sow the seed, and reap the harvest. If we look

through the history of this country, we shall find some striking facts which bear upon this subject. At the beginning of this century men were talking of "the inexhaustible fertility" of the western portion of the State of Vermont. In 1825 they were talking about "the inexhaustible fertility" of the Mohawk and Genesee valleys in the State of New York. I have looked over the files of an agricultural paper published at Albany in 1834, and several years subsequently, and it is amusing to see the character of the articles running through all those papers. They simply held out the idea that there was no limit to the productive capacity of the soil. It is true that a few thinking men, who were looking forward, claimed that exhaustion of the fertility of the soil was possible, and some even went so far as to say that in some parts of that section evidences of such exhaustion were already manifesting themselves; but, on the other hand, the great majority of the writers took the ground that the soil could never be impoverished, and that the farmers could go on raising wheat year after year, putting nothing back upon the soil, but dumping their manure into the canal or burning it, anything to get rid of it. Then about the year 1850 we find this "inexhaustible fertility" that they talked about located farther west. For some reason it had crept toward the west, and at that time had got as far as Ohio. In 1875 it had pushed out as far as Minnesota; and in 1890 we find that it has gone still farther, and men are now talking about the "inexhaustible fertility" of the Red River valley.

But in this section of the country men have ceased to talk about "the inexhaustible fertility of the soil." In fact, that is a thing that does not exist, and never has existed. We come, then, to the second period, that of soil exhaustion. When this period is reached in any agricultural country, it is really a blessing to that country. By the continued cropping of one kind of crop, wheat, for example, as was the case in some parts of the Mohawk and Genesee valleys fifty-five or sixty years ago, the elements of plant food required to produce a crop of wheat were entirely exhausted, the crops failed, and men began to ask themselves the question, "Why is it that our fields yield less and less crops

yearly?" Now, in the asking of that one question we have the origin of the condition which leads to agricultural investigation and agricultural study, and we have the beginning of agricultural progress, of the improvement of agricultural methods. If a man could continually raise twenty, thirty or forty bushels of wheat to the acre, or I will say thirty bushels per acre, year after year, without any thought or care except to plough the ground, sow the seed and gather the crop, then there would be no occasion for study. Most men are so constituted that they are willing to do as little as they can, and still succeed in their business. If we can get good food, good clothes, and comfortable quarters, with little effort, we are apt to accept the conditions and not seek for harder work with less compensation; yet, while this is true, no one believes that manhood, self-reliance and the mental faculties can be best developed where there are no obstacles to overcome. The inhabitant of the tropics gets what clothing he wants and his daily food for a very small expenditure of energy, while the New Englander struggles with a hard soil, a severe climate, and sharp competition; and it is true the world over, that just in proportion as the soil becomes exhausted, just in the same proportion does the mind of the agricultural population become enriched. An exhausted soil is the ideal condition for the development of agricultural research and agricultural investigation. It is during this second period, the period of exhaustion, as I have chosen to term it, that we find the beginning of advancement in agriculture. Liebig's work and Davy's work in agricultural chemistry, the beginnings of our knowledge of chemistry as applied to agriculture in England and in Germany, belong to that period. Scientific men turned their attention to the matter of plant growth and plant food, simply because they wanted to find out the reason why soil that had been continually cropped did not produce as large crops as formerly.

I have taken up more time with this part of my subject than I intended, and I pass to the third period, the period of renovation, or the period of restoring fertility to the soil. Here is where we find better methods of agriculture. Here is where we find new substances introduced to furnish food

for plants and also for animals. In fact, every subject appertaining to the business of the farmer has been the subject of study, and we have improved machinery, improved tools, improved methods, and improved everything that helps the farmer to succeed. Take, for example, the work of those great experimenters who first applied science to the art of agriculture,— Lawes and Gilbert of England. They started their work in 1843. Their first investigations were with manures, seeking to determine how the farmer could use manure to the best advantage in the raising of crops. Next they endeavored to find substitutes for barnyard manure. They commenced with the use of bones and other substances like the Spanish rock, coprolites, etc., which contain a large proportion of phosphate of lime. In other words, they were studying the question of plant food, and seeking for materials which could be used as nutriment for plants. When we turn back to the beginning of the use of what are now called commercial fertilizers, we find that bones were first used in the last part of the last century, and then came the use of substitutes for bones, including the "South Carolina rock," which has been largely used in this country and exported to a great extent to foreign countries. Then came the German potash salts, nitrate of soda, sulphate of ammonia, and other materials which are dug from the earth or are waste products from other industries. The work of these pioneer investigators was not confined to plant nutrition; they also considered the matter of rational stock feeding; and while the Germans, under the lead of Wolff and Kuhn, have been leaders in the work of making stock feeding a science, yet Lawes and Gilbert have contributed much towards the accomplishment of this result.

Having considered these three periods in the history of agriculture, I want just to recapitulate. First we have the so-called period of inexhaustible fertility, when it was thought that the soil would continue to yield abundant crops indefinitely, without the application of any fertilizer. Then we have the period of exhaustion, when the soil has become exhausted of plant food, and will no longer produce a good crop. Then comes the third period, the period of renovation, when we are asking how we can overcome the results

of the errors of previous methods of farming. It is in this period that the investigations of agricultural chemists are brought to bear upon the question, and we have now to consider the practical results of these investigations.

How shall we measure the value of experiment stations? You all know very well what they are, that they are simply institutions which are devoted, and intended to be devoted, to the carrying on of those experiments which are necessary in order to determine the best means to overcome the obstacles which stand in the way of successful agriculture. And how shall we measure the value and usefulness of their work? Let us start with the measure of values in general. We must take some standard or unit of measure. The dollar is the unit of measure in the world of commerce and in the world of exchanges. By this standard we measure the success or failure of men in all the business occupations of life. Can we apply such a standard as this to the results of the work of the agricultural experiment stations? No, we cannot. I will admit that freely, to start with. We cannot measure their work in any such way. There is no one who would attempt to measure in dollars and cents the influence of Harvard College in Massachusetts or in the whole country. You would not attempt to measure the value of the schools and other educational institutions of Worcester in dollars and cents. You would not attempt to say how many dollars the churches of Worcester were worth to the city. You could not tell anything about it. There are other factors entering into the question of their success or failure, aside from dollars. It is true that we like to have anything that we undertake yield dollars, and of course in all financial operations it is the legitimate measure; but there are influences resulting from our educational institutions which cannot be measured by this standard. This same thing is true very largely of the agricultural experiment stations. We cannot tell in dollars and cents what they have done, but we have good reason to believe that they have done good and that they are now doing good; and we can pick out certain definite things, as I shall do later, and show wherein they have been beneficial, and in that way we can to some extent measure their usefulness and make an approximate estimate of their value.

I will pass on to a consideration of what they have accomplished, and when I say this I wish you to bear in mind that I do not profess to be able to measure, nor do I believe any man can, their full value or their full usefulness. In 1889 tnere were printed and sent out by the various experiment stations in the United States 280 bulletins and reports, including 10,000 pages of printed matter. I have no means of knowing, and have seen no figures showing the mailing lists of the various stations, I can simply give the fact in regard to our own State. We have in New Hampshire a mailing list of 7,000 farmers who receive every bulletin and report that is sent out. Then there are other ways which we have of getting the results of our work before the farmeis of the State, through farmers' institutes, agricultural papers, etc.

From among these bulletins I have selected a few for the purpose of showing just where they have been of practical value. I have here a bulletin from Cornell University, Bulletin No. 13, in which the subject of manures is treated, the results of which you have seen in the agricultural papers, because this bulletin has been very widely copied. Let us look for a moment at the loss which results from careless methods of handling barnyard manures. Professor Roberts, the director of the station, says that their experiment, which was conducted by taking certain portions of horse manure from the yard and analyzing it, and then exposing it to the effect of rain, showed that there was a loss from a ton of manure by leaching of $1.03, which represents 42 per cent of the entire value. Now, this represents a loss of over $6.00 per year on each and every horse where the manure is left exposed and unprotected. We have in the United States 13,173,000 horses. Professor Roberts says that, from his experience in the State of New York, a large majority of the farmers leave their manure out in this way unprotected. But let us suppose that only one-third of it is left exposed; we there have a loss which might have been prevented, and which amounts to nearly $26,000,000. If Bulletin No. 13 of the Cornell University Experiment Station could be properly appreciated, much of this would be saved. I have no doubt that one-third of the value of all the horse manure in the country is sacrificed in this way. In the same bulletin the

loss from the manure of cows is shown to be 22 cents per ton, or $1.75 yearly. There are 50,000,000 cattle in the United States. Roughly speaking, I suppose that one-third of the cow manure is left exposed in this way. That represents a loss of $30,000,000. Now, I claim that the teachings of this one experiment station bulletin must be of inestimable value to the farmers of the country.

I pass to another one, which is still more striking,—Bulletin No. 25 from the University of Wisconsin, in which Professor Henry, who, in my opinion, is one of the best investigators in this country, reports the results of a series of experiments in feeding bone meal and hard-wood ashes to hogs. It is a question that is not new, but I think the result has never been brought out in its full force as Professor Henry has brought it out in this bulletin. He fed ashes and ground bone, and effected a saving of 28 per cent of the total food required. That is to say, if it required a certain amount of food to produce 100 pounds of pork without ashes and bone, then with ashes and bone there was a saving of 28 per cent of that food. Now, I find by the census that there are 44,000,000 hogs in the United States. Estimating the average weight at 150 pounds, we have 66,000,000 pounds. Now, it requires about five pounds of corn meal daily for 100 pounds. That makes 3,300,000 pounds or 1,650 tons daily, which must be fed to the hogs of the country. Valuing that at $33,000, a saving of 25 per cent amounts to $8,250 daily, or $3,000,000 annually. I do not pretend that these figures are exact; they simply show what is possible. They show that by so simple a thing as furnishing a certain proportion of bone meal and ashes in the feed of hogs, where corn is largely used, a great saving can be made, and Professor Henry has brought this out in a very forcible way.

I pass to Bulletin No. 5, from the Storrs Experiment Station, which is under the charge of Professor Atwater. This bulletin treats of a subject that has been in dispute ever since the beginning of scientific agricultural experiments, and that is, the source of nitrogen as food for plants. Every pound of nitrogen that is purchased in any form of fertilizer costs about 17 cents. It is an element that exists in the

atmosphere in great abundance, and there has been much dispute over the question, whether or not plants get their supply of nitrogen from the ground or from the atmosphere. If they can get it from the atmosphere, then there is no need of furnishing this important element, nitrogen, in fertilizers. Professor Atwater, following up the work which was started by the French chemist Ville and carried on by Boussingault and others for several years, has found that some plants do actually avail themselves of the nitrogen in the atmosphere. He found that clover, beans and other leguminous plants, can and do gather nitrogen from the air. He states very strongly that he is convinced — and from the evidence given in this bulletin I think he is right — that they can take up nitrogen from the air and store it in the soil, where it can be used as food by other plants. What does that mean? I have a few figures here which show what it means. In New Hampshire we use $200,000 worth of fertilizers every year. One-third of the cost of these fertilizers is in nitrogen; therefore, $66,000 of this $200,000 represents the cost of the nitrogen that is contained in these fertilizers. The farmers of New Hampshire are paying every year $66,000 for nitrogen. In Massachusetts they are paying very much more. How much is paid in the whole country I have no idea; but the point is, that a portion of this, at least, can be saved. Now, it has been known for some time, it has been brought out very clearly by the experiments of Lawes and Gilbert, that clover, in their country, under their conditions, takes up nitrogen; and there it is the custom to grow clover and plough in the stubble to furnish a supply of nitrogen for the succeeding crop, say of wheat. Now, if there is stored up in the atmosphere a supply of nitrogen, and if the leguminous plants can gather and make use of this as food, then we can save this great expense which is incurred in furnishing it to the plants in the form of nitrate of soda or in other forms. This is another point which has been brought out before the country by an experiment station. What its value will be to the whole country, nobody can tell. I have simply undertaken to give some idea of its value to the State of New Hampshire, as an illustration.

I pass on to Bulletin No. 32, from the Massachusetts Experiment Station. In this bulletin Dr. Goessmann gives the results of certain tests which he has been making, with which you are much more familiar than I am, with reference to the production of milk and the relative economy of different cows. I have condensed the whole of it. Here is the excess of income over the cost of food. That is, taking the cost of the food of each cow for a given length of time, and the total income from the milk, I find that the best cow gave an excess of income of $93.25, and the poorest cow showed a deficiency of $3.97; that is, $3.97 worse than nothing, besides all the time spent in taking care of her. Now, the question for Massachusetts farmers, — and I want to say right here that it is equally true with us in New Hampshire, — the question for Massachusetts farmers to consider is, how many best cows they have, and how many of the poorest. I want to say to you that if you will study the bulletin of Dr. Goessmann you will be bound to study the character of the cows you are feeding, in order to be able to answer that question. I find that there are about two of the poorest to one of the best. We want to find the cows that are worse than no cows at all. How are you to do this? Right here is where the experiment stations have aided the farmers of the country. They have given to every farmer the means of finding out what his cows are worth, because they have put into the hands of every farmer methods of determining the percentage of fat in his milk. Now, it is not expected that every farmer will become a chemist, and be able to analyze his own soil and find out just what should be applied to it, in order to raise a given crop; but it is possible, by the simple methods of milk analysis, now so numerous, for almost every one, with a little care and experience, to make very accurate determinations of the butter value of milk, both of herds and individuals. Of the numerous methods, the simplest seems to be that of H. F. Beimling of Philadelphia. Its superiority for general use is that only about ten minutes' time is required to complete a test of six or twelve samples, according to the size of the machine. Babcock's test is also a promising one; while Parsons, Short, Patrick, Cochran and others have methods each of which

gives satisfactory results. Now, what does that mean? It means that a man who has ten cows should purchase this little invention, which costs from twenty to thirty dollars, and test the milk from those cows, keep a record of the tests, and the one that is a defaulter to the amount of three dollars a year, less or more, should be sent to the butcher, and the one that just barely pays her way should go also.

There are other points that might be touched upon; in fact, there are so many that I do not know that I will attempt to refer to any others. I will simply say that, while the experiment stations are making a great many mistakes, yet they are doing much good work. But there are certain duties on the part of the farmers toward the experiment stations. Do not for a moment think that all the duties are with the experiment stations. It is simply the old story of leading a horse to drink. It does not take a very able-bodied man to lead a moderately docile horse to drink, but it certainly does require a good deal of engineering and a good deal of skill to make the horse drink if he is not disposed to do so. Now, the same thing is true of the experiment stations. The results which Professor Goessmann, Professor Henry, or anybody else have given, if you do not study them and do not apply them, are of no use to you. But the experiment stations are not to blame for that. Take the matter of stock feeding. I will just allude to it, as showing the importance to the farmers of this country of saving one cent per day in the cost of feeding cows. It seems like a small matter, but the aggregate amount is quite a large sum. The experiment stations of this country have published bulletins giving instructions that will enable almost any farmer to save one cent per day in the food of every cow, and at the same time secure as good results as he does with his present method of feeding. What does that mean? A saving of one cent per day on cows alone in the State of New Hampshire means $1,000 per day, or $200,000 per year. There are some of our farmers who appreciate the importance of this saving, and some are saving two or three cents a day in feeding their cattle; and I believe that it is possible to save three cents a day by studying and applying the most

economical methods of feeding. A saving of one cent a day means $400,000 per winter in the State of Massachusetts, and in the United States it means $30,000,000. I do not mean to say that $30,000,000 will be saved in the United States, or that $200,000 will be saved in New Hampshire, or that $400,000 will be saved in Massachusetts; but I do say that these amounts can be saved in the cost of feeding our cows.

I will not take up any more of your time, unless there are some questions asked.

Secretary SESSIONS. I would like to call your attention to one point. You spoke of feeding pigs with ashes and bone. Would the same result follow where skim-milk formed a considerable part of the ration?

Professor WHITCHER. No, I think not. But the great mass of hogs in this country are fed on corn from the time they are weaned until they are slaughtered. It would not be true where skim-milk is a part of the ration, because that contains the ash constituents which are necessary.

Mr. ELLIOTT MOORE. I would like to inquire of the speaker whether manure that was spread on the field say this last week, and is allowed to remain there until next spring, will waste?

Professor WHITCHER. I am very glad to have that question brought up. We have been studying it at our station for the last four years, and I will say, to answer the question as directly as possible, that I do not believe there is any loss to speak of, and I do believe that the gain there is in the condition in which the manure will be next spring will more than offset any little loss that there may have been. Now, I must qualify that a little, because I know there are some in the audience who will take exception to that statement unless it is qualified. There is one way in which you may lose. I would not put it on a steep hill-side, but, if the field is level or comparatively level, I do not believe that any loss results from that method of dealing with it, and for this reason: the first thing that takes place in the spring after the snow goes off is a softening of the earth under the manure, the water dissolves the plant food that is contained

in the manure, and it is washed down and settles in the soil. Now, it is a fact that, if you can filter the water that comes from the manure through three inches of earth, it takes up that manure. Consequently, if the water passes into the ground before it runs off, there is no loss. There is no loss in the atmosphere. One of the old notions was that, because you could smell manure at a long distance, there had been a great loss of the elements of fertility in that manure. The fact is, that what passes off into the atmosphere is not plant food at all. I have a record of some experiments with manure spread on the field in the fall which show that it had fifteen per cent more value than the same manure spread and ploughed under the next spring.

Mr. Edmund Hersey of Hingham. I have noticed in going around the country that a great many farmers leave their manure in heaps. I wish the lecturer would explain to the audience the loss or gain in so doing.

Professor Whitcher. That gain will be a loss. The reason why it will be a loss is simply this. I do not mean to say that there will be an absolute loss of material there, but its effect will be concentrated in spots. For ten years after manure has been left in that way, you will be able to distinguish the spot where a heap of manure was left. I have had considerable experience in this matter. Two or three years ago I drew out about a hundred loads of manure, and left it in that way through the winter. It came on quite cold before we could spread it. We ought to have had one of those manure spreaders which the Richardson Manufacturing Company sell. That manure laid in heaps through the winter, and we did not get more than half its actual value. I doubt if we ever shall.

Mr. Hersey. I would like to ask if there is not an actual loss by leaving manure in the field, provided it heats?

Professor Whitcher. There is no doubt about that; but, when left in small heaps, such as I have in mind, it very seldom heats. Of course you get fermentation when you get heat, and in that case you lose some of the value of the manure, especially of the liquid part. But, when left in small heaps, say seven or eight to a cart-load, it seldom heats.

Mr. B. P. Ware of Marblehead. Market gardeners make what they call a compost heap for the purpose of producing fermentation. Is the gain that the farmer or market gardener will derive by applying that manure after it has gone through the process of fermentation, which is supposed to render it more readily available as plant food, greater than the loss which will be occasioned by the process of fermentation?

Professor Whitcher. That is a very difficult question to answer, because nobody can tell. I suppose it might be accepted as good proof that the advantage is greater than the disadvantage, from the fact that most market gardeners do that very thing. When we get down to the average judgment of any particular class who have studied their business as market gardeners have done, their judgment is very liable to be right. I have faith enough in humanity to believe that this is true, and when I find the teachings of what I believe to be science run contrary to that, I am pretty careful to look the teachings over again, to see if somebody has not made a mistake. I am inclined to think that the advantage is not due, as you have suggested, to the plant food being rendered more readily available, because I do not think that is true, but I think it is in a better mechanical condition, and therefore more generally distributed through the ground. I think it is due more to the mechanical condition than to any chemical change that results from fermentation. Fermentation does result in a loss of nitrogen; but, on the other hand, there may be such a supply of nitrogen left in the manure that the greater uniformity with which it can be distributed through the soil more than makes up for any loss in the process of fermentation. I think that may be true; but, on the other hand, I do not know but that there are other ways of getting the manure in just as good shape, and still save the nitrogen. I think it could be done. I should want to try it if I were engaged in that kind of work.

Secretary Sessions. The first question that was asked in regard to spreading manure limited it to manure that was put on the ground late in the fall, and remained through the winter. Would you answer the question in the same way, if the manure was spread on the land in August or September?

Professor WHITCHER. I would rather have it put on the land in August or September than late in the fall or in the winter.

Secretary SESSIONS. Why?

Professor WHITCHER. Because the fall rains would wash the plant food into the soil, and there would be no danger of its running off, as there is when the soil is frozen. I believe the safe rule, the correct rule, is to apply manure just as soon as possible after it is produced. If it lies in the barn cellar it ferments, and there is some loss; if it lies under the eaves there is a washing out, — a big loss. If it is put onto the soil as soon as produced, whatever leaching there is goes into the soil. I would draw out manure any day in the year after the field was cleared so that a team could get there, even if the snow were two feet deep. We practice this method, and I believe it is the correct one. Get it out of the stable and onto the ground as soon as possible. Putting manure on a field at any time, unless the ground is very steep, in my opinion does not involve any loss.

Mr. CHARLES PARKER of Holden. Would it not be far better to use a harrow or plough when it is put on the field in August or September, and cover it up?

Professor WHITCHER. Yes, it would be better because of the fact that, if the manure dries on the surface, it gets into very hard lumps; whereas, if it is worked into the soil, it will be kept moist. Still, that practice could not be carried out with us, because we draw it out when the land is frozen; but I think the suggestion is a good one, — that it should be mixed with the soil, if possible.

Mr. HERSEY. Is there not another loss in allowing manure to decompose in a heap, through the escape of carbonic acid gas? Is not that beneficial to the soil? When it escapes in the soil, does it not hasten the decomposition of the soil itself, and thus let loose the plant food that is in the soil, and may it not be also beneficial to the growth of plants? As common air contains only about 6 parts in 10,000 of carbonic acid gas, would it not be beneficial to the growth of plants to have some of it escape from the soil while it was escaping from the manure in the process of decomposition?

Professor WHITCHER. I do not think there would be very much of a point there, from the fact that plants do not take up carbonic acid through their roots; the carbonic acid of the plant is taken in through the leaves, and comes from the atmosphere; and, while the amount of carbonic acid in the atmosphere is very small, nevertheless it is always amply sufficient to supply the amount that is required for the growth of large crops. In other words, if we furnish everything else that the plant needs, the plant will take care of itself, so far as obtaining a sufficient quantity of carbonic acid.

Mr. HERSEY. What amount of carbonic acid do plants require?

Professor WHITCHER. There have been a good many experiments made, showing different percentages; but, if I remember correctly, there has been no advantage shown in increasing the amount above that contained in the atmosphere.

Mr. HERSEY. Is there not some German authority who tells us that plants grow best in eleven per cent of carbonic acid gas?

Professor WHITCHER. Eleven per cent would be a pretty heavy dose of carbonic acid, and would prove injurious to most plants.

Mr. HERSEY. I know it would be; but, as the result of some experiment that was tried, it was stated that common soil contained from 37 to 125 parts in 10,000, but that well-manured soil after a heavy rain, in warm weather, contained 1,300 parts of carbonic acid gas. I think it is well to bring this up, because I think it is one of the things that the experiment station should take hold of and ascertain beyond the possibility of doubt whether we are losing anything by losing the carbonic acid gas from our manures or not, and whether the common air has enough for the excessive growth of plants which we require. I have no doubt that there is carbonic acid gas enough in the common air for the growth of forests; but I very much doubt whether the average amount is sufficient for the growth which we demand in our gardens.

Professor WHITCHER. I would like to say, in connection

with that, that I do not see how we can very well regulate that matter. Even allowing that there ought to be more carbonic acid in the atmosphere than there is, how are you going to get it there or keep it there? The wind will blow it away. It has been thoroughly demonstrated that plants do not derive their carbonic acid through their roots. If we could control it, it would be all right; but, suppose we should get a little more carbonic acid over our corn field, our neighbor will get it, if he lives on the windward side.

Mr. HERSEY. It seems to me that if we fill our soil at no cost with carbonic acid gas, a considerable portion of it would naturally escape to the air and surround the plants, and thus the plants would take up what they needed; and, if there was any left, it would be all well enough for the neighbors to have it.

Professor WHITCHER. If there was any possibility of appreciably increasing the amount of carbonic acid in the atmosphere, the increased consumption of coal that is going on at present ought to have had an effect before now; and yet the results of analyses show that the carbonic acid in the atmosphere remains practically unchanged. Of course we cannot tell absolutely, because the methods of determining the amount of carbonic acid in the atmosphere employed by the early experimenters may have been faulty; but I think there is no belief among scientific men that the amount of carbonic acid is increasing.

Mr. E. B. LYNDE of West Brookfield. My neighbor sitting here by my side, and I, have been discussing the question of manure. He practices spreading his manure on his grass ground and ploughing it under; I do not. My manure all drops into the cellar, and never freezes; but, notwithstanding that it can remain there until spring and never freeze, I carry it out as fast as it is made, no matter if the snow is two feet deep. I have never practiced ploughing manure under upon grass land. It seems to me that there would be likely to be a loss if it is treated in that way.

QUESTION. What is the character of your soil?

Mr. LYNDE. A sandy loam.

Secretary SESSIONS. I wish Professor Whitcher would touch upon the matter of leaching, in answering that question.

Professor WHITCHER. The practice of the gentleman accords entirely with what I believe. I do not believe in burying manure. There used to be a notion that manure had a wonderful tendency to climb, and that we would lose a great part of its value in the atmosphere if it was not buried pretty deeply; but the fact is that the loss of manure is in the other direction, — downward. The water that passes through the manure soaks down into the subsoil, especially where you have a sandy subsoil. It goes down much faster in a subsoil of that character than it does in a clayey one. That is one danger in burying it too deep. Again, decomposition does not take place so rapidly as when it is near the surface, and therefore it is not so rapidly made available for the crop. My belief is that it should be kept near the surface and mixed as thoroughly with the soil as possible, not carrying it down more than two or three inches, and then let the water wash the plant food down, and distribute it through the rest of the soil. The loss, as I have said, is downward, not upward.

Mr. LYNDE. I am in the habit of using sand as an absorbent. Now, is that the best way to save the plant food, and does it pay? Of course there is an expense in carting the sand in, there is a good deal of time spent in spreading it in the gutter, and then it takes time to move it onto the field. Is that practice a paying one?

Professor WHITCHER. Perhaps I can give my idea of that by stating what we do. We buy sawdust and go five miles to get it, whereas we could get sand for much less, and would only have to go about two hundred rods to get it. We had rather pay ten times as much for sawdust, and take all the labor of hauling it the extra distance, than use sand.

Mr. LYNDE. Why?

Professor WHITCHER. I will tell you why. In the first place, the sawdust is very light to handle. In the second place, if you have cows you can keep them clean much more easily. If you use sand, it gets onto their udders and drops into the milk. You may say that you can clean the udders and get the sand off, but the man who will do that must be a better man than I can hire. Another thing is, a given amount of sawdust will absorb a great

deal more water than the same amount of sand. Still further, the manure that is produced from sawdust is in much finer mechanical condition, and better fitted for use on market gardens or anywhere else.

Mr. HERSEY. Would you use sawdust for bedding?

Professor WHITCHER. Yes, sir. I do not believe that two or three bushels of sawdust mixed with several million pounds of earth will very greatly disturb the soil, the farmer, or anybody else. I do not think there is any damage whatever from the use of sawdust; and I do think there are great advantages in getting the manure in a fine mechanical condition.

Mr. R. L. SADD of Connecticut. I would like to ask the professor what he considers the best method of preserving the liquid manure, and how to apply it in order to get the best results? Do we not save it all if we have a tight cellar under the cows?

Professor WHITCHER. Do I understand that you want to save the manure as liquid manure?

Mr. SADD. How are we to save it and apply it to the soil?

Professor WHITCHER. My idea would be to use sawdust or leaf mold for bedding, which would absorb all the urine.

Mr. SADD. Could you save it any better than you could by putting it into a tight cellar?

Professor WHITCHER. I have never had any experience with these tight cellars, but I have an idea that the manure would be very apt to come out very wet and in bad shape to handle. I don't know whether you use any bedding, or not.

Mr. SADD. We use bog hay for bedding, and save it in that way. We increase the value of the manure, we think, nearly double by doing so.

Professor WHITCHER. The only thing I can suggest is that you must use enough bedding to absorb all the urine.

Mr. SADD. Have you ever tried any experiments to determine the relative value of solid and liquid manures?

Professor WHITCHER. No, sir; I have not. It has been tested in England, but not in this country.

Mr. LYNDE. At the Amherst Experiment Station, as I understood you, the best cow gave a profit of ninety-three dollars, and the poorest a loss of three dollars. I keep a dairy, I sell milk, and I raise stock; that is my business. Now, it is very desirable to have cows that will give ninety-three dollars profit, rather than cows that will make a loss of three dollars. I would like to have the professor tell us how we are going to get cows that will give ninety-three dollars profit, and how long it will take us to do it. Gentlemen who are breeding in order to obtain the very best stock know that there are some difficulties in determining on the calf that will make a first-class cow.

Professor WHITCHER. That is a very hard question. Its answer would involve an hour's talk; but I will tell you two or three points that can be brought out in that connection. In the first place, it is the same old answer that applies to everything. The question is often asked, "If everybody did so-and-so, what would be the result?" In the first place, everybody will not do it. It is quite possible for everybody to do it, but we know that they will not. In the second place, if you do not start for a given place, you certainly will not get there. Now, the question of time has really nothing to do with it. If all the farmers of Massachusetts want to get that class of cows, they have got to make a beginning; they cannot all get them at once, they have got to be obtained by careful breeding and by selection. There is an argument in favor of farmers raising their own cows. I understand that the milkmen of Massachusetts are not breeding their own cows to any great extent, but they are trusting to other people to do the breeding. If a man has a herd of fifty cows, and is making butter, he has a method of testing them which will enable him to determine whether each individual cow is profitable, or not. Up in New Hampshire we are interested in making butter, and therefore the value of milk for the production of cream comes in. In Massachusetts, if a man's milk is above the legal standard, he does not have much trouble; if it is a little below it, he is all right; if it is a good deal below it, he is likely to get into difficulty. Suppose a man has fifty cows, and thirty of them are first class or moderately profitable, and the remain-

ing twenty are either just on the border line of profit and loss or are a positive loss, is it not better for that man to run those thirty profitable cows, and let the others which are eating up the profits of the good ones go to the butcher, and curtail his business until he can increase his herd by selection? This question of selection is a question of judgment on the part of the breeder.

Mr. J. S. Perry of Worcester. This question which is under discussion at the present time is a question that I have seen agitated in the papers and heard spoken of a great deal. It is one that I do not believe any of us are wise enough to fathom. It is all very well for the speaker to say, "Sift out your cows." Our agricultural papers say, "Why don't you sift out your cows, and sell the poor ones for beef? If you will do that, your cows will pay a profit." I have had a little experience in keeping cows, and I have found out one thing. Here is a cow that will give twenty quarts of milk a day for a certain season; she is all right every way. The next season that cow will come in in just as good shape every way as regards flesh and all surrounding circumstances, as far as the observation of man can perceive, but that season she will give but ten quarts of milk a day. Now, I say no matter how wise we are in regard to breeding cows, this is a fact, and there is not a milkman in this hall who will not substantiate what I say. What real benefit is it to weed out our cows, as we are told to do by the professor, as we are told to do by the agricultural papers? Every man who keeps cows will testify that a cow that does well one year or perhaps for a series of years is very apt to have an off year. I do not believe there is a man in the hall who will not agree with me in this statement. The sifting out of cows is an impossible thing. Then in regard to breeds. I have gone out and bought little scrub cows for twenty or twenty-five dollars, and I have paid a hundred dollars for cows; and I have found that the little scrub cows beat the hundred-dollar cows. Now, what are you going to do about it? I would like to ask the professor if he can tell me why it is that a cow in good health, apparently, will give twenty quarts per day one year and another year but ten?

Mr. Ware. I am surprised that our friend who is so wise in most things should display such poor judgment in paying a hundred dollars for those cows.

Professor Whitcher. Of course I cannot explain any such thing as that. All I can say is, that I should not expect that cow to come back the next year to twenty quarts a day. If she had dropped down from twenty to ten, I should expect her to continue to give but ten quarts a day.

Mr. Lynde. That is not so. I have known them to come down to ten quarts, and go up to twenty-two.

Professor Whitcher. Are you talking about averages throughout the whole year, or are you talking about the best thing a cow can do after calving? Sometimes a cow will come in and give a large amount of milk for a short period of time, and then taper right off.

Mr. Lynde. That is not what Mr. Perry means. He means that she gives that amount of milk throughout the year, and he can see no reason why she should not do as well the next year as she did formerly.

Professor Whitcher. I would like to know how common that thing is?

Mr. Lynde. I do not say it is a common thing, but it is sometimes the case.

Professor Whitcher. It has never been the case in my experience. I doubt very much if it is a common occurrence.

Mr. Chamberlain. Several years ago there was a milk law passed, which established a standard, and some twenty of my cows do not come up to that standard. What shall I do? Mr. Wheeler of Grafton, a very large producer of milk, said the only thing he could do was to turn the milk of his twelve grade cows into butter, and then he had hard work to keep up to the standard.

Professor Whitcher. That opens up a very dangerous subject for discussion. We have some definite ideas in regard to it ourselves. I do not believe in a law that causes adulterated milk to pass muster, while the pure article is condemned as adulterated. Therefore I do not have much sympathy with the milk laws as they are now. As a matter

of fact, a cow that gives a large yield of milk does not give phenomenally rich milk. I might illustrate. We have a pretty good chance to study this question. We have four breeds, and four cows of each breed. Now, the cow that gives the largest amount of milk gives milk that would not pass if subjected to the test in New Hampshire or Massachusetts. On the other hand, the cow that gives six and one-half per cent of fat is the cow that gives the smallest quantity of milk. Her milk costs $1.35 per hundred pounds, and the cow that gives the large quantity of milk produces it at a cost of about $0.68 per hundred. The two things, quantity and quality, must be taken into consideration. All the twenty-quart cows do not come up to the standard. I think a twenty-quart cow that will come up to the standard is a pretty hard thing to get. I think the milk laws will have to be modified in the next ten years.

Mr. Dyer. I want to inquire about the tests that the professor has mentioned. Does he recommend Babcock's as the most practical one for the average farmer to use?

Professor Whitcher. I do not know as I would recommend that as the best. I think I would recommend Beimling's. It has been recommended by Professor Cooke of the Vermont Experiment Station. The advantage is that much less time is required to make a test. I have never seen the machine myself, but Professor Cooke's recommendation leads me to think it is a good thing.

Mr. Dyer. Is there any practicable way of testing our cows without the use of those things which you speak of?

Professor Whitcher. The one I speak of is really as simple as anything that has any accuracy at all. Of course there is the old cream test, which I don't believe any one seriously believes to be of any use. There is also the churn test. It is not a scientific test, but it is a good commercial one. If it takes twenty pounds of the milk of one cow to make a pound of butter, and it takes twenty-five or twenty-six pounds of another cow's milk to make a pound, you have the relative value of the milk of those two cows; but it is not a very accurate matter, because the butter will contain a greater or less amount of water. I think Beimling's and

Babcock's tests are simple enough, and they are certainly very accurate, and not very expensive.

Mr. LYNDE. Will you tell us about the expense?

Professor WHITCHER. Beimling's costs about $24.

Mr. EATON. On this question of milk I am not very clear. Judging from my own experience, I think that Mr. Perry's statements are correct. I have one cow in mind that gave the most milk when she was thirteen years old that she ever did in her life.

Professor WHITCHER. Of course there is no doubt that cows do vary in the quantity of their milk.

Mr. SADD. What breed of cows do you call the best?

Professor WHITCHER. That is another dangerous subject. I think I will not answer that question. Not that I am afraid to, at all, but, at the same time, it seems to me it would be as well not to open it.

Adjourned to 1.30.

## AFTERNOON SESSION.

The meeting was called to order by the chairman, Mr. HARTSHORN, at 2 o'clock.

The CHAIRMAN. The lecture this afternoon is on the "Birds of Massachusetts," by Dr. B. H. Warren of West Chester, Penn., State ornithologist of Pennsylvania.

## BIRDS OF MASSACHUSETTS.

BY DR. B. H. WARREN, ORNITHOLOGIST PENNSYLVANIA STATE BOARD OF AGRICULTURE, WEST CHESTER, PENN.

MR. PRESIDENT, LADIES AND GENTLEMEN:—It gives me great pleasure to be able to address an intelligent body of representative farmers from all portions of this great Commonwealth. It is only within the last few years that the subject of the food of birds has been made a special study by ornithological specialists. In this particular line of investigation the division of ornithology, in charge of Dr. C. Hart Merriam, an indefatigable worker and one of the most eminent naturalists in America, has done and is doing a great and valuable work. Dr. Merriam's division,

a branch of the United States department of agriculture, receives annually a small appropriation for the purpose of investigating the economic relations of birds and mammals. Several reports of great value to both farmers and naturalists have been issued by Dr. Merriam and his corps of able assistants; other reports, now in course of preparation, will be equally as interesting and valuable as the previous documents prepared and distributed through Dr. Merriam's untiring efforts.

The bird fauna of Massachusetts, according to the admirable list of Prof. J. A. Allen,* includes about three hundred and forty well-authenticated species and sub-species. This large number embraces birds which are found in the Commonwealth as residents and transitory visitants. Species which live in a particular region during all months of the year are termed by naturalists residents. The crow, red-tailed hawk, and the English or European house sparrow are common and resident. The term winter resident is applied, usually, to those species which migrate northward, and rear their young, as many of them do, in the Arctic regions, but which reside here during the winter season. Many different kinds of ducks, some geese, certain loons, and various species of land birds, visit the boreal regions, where, during the fleeting Arctic summer they bring forth their young in dreary solitudes rarely visited by man. The snowy owl, snowbird, shore lark, and tree sparrow are winter residents.

Summer residents are native birds, or those which spend the winter in the tropical, sub-tropical and warmer temperate regions, and in the spring migrate northward to their breeding grounds. The cat-bird, wren, robin, oriole, the swallows and blackbirds are familiar examples of summer residents.

Various warblers and many other land birds, as well as numerous representatives of the water birds, occur in this region only during the spring and fall months. They are designated spring and fall migrants. A straggler or accidental visitant is any bird which wanders from its usual geographical range.

* "A Revised List of the Birds of Massachusetts," by J. A. Allen, from Bull. Amer. Mus. Nat. Hist., Vol. I., No. 7, July, 1886.

### *Water Birds.*

About one hundred and fifty species of water birds, of which less than thirty are reported as breeding, are found in Massachusetts. These birds, as the name would signify, frequent almost perpetually the water. Some species inhabit rivers, creeks, lakes and ponds; while others, such as the auks, puffins, guillemots and petrels, are oceanic birds, and rarely are found inland unless driven thither by severe storms. Grebes and loons live almost constantly in the water. The jaegers, gulls and terns are common along the Atlantic coast, but they are not, strictly speaking, oceanic, as many of them when migrating are found inland, and some of the gulls and terns are regular summer residents on the large lakes in the interior.

Numerous species of geese, ducks and swans *(Anseres)* are highly esteemed for table purposes, and largely sought after by sportsmen. Some ducks and certain geese prefer to dwell on the ocean, but others, and in fact the majority, find congenial resorts in bays, lakes and the large rivers. The herons, bitterns and egrets inhabit swamps, bogs and secluded water courses in all parts of the State. These waders are common during the winter in the South Atlantic and Gulf States, but on the approach of spring they come northward along the Atlantic coast as well as in the interior. Species breed from the Arctic countries southward.

The rails, gallinules and coots *(Paludicolæ)* seek the most secluded situations, in oftentimes almost impenetrable swamps and marshes, where they rear their young in safety from the interference of man, amid the thick reeds and sedges. Rails collect in large numbers, during the late summer and fall before migrating southward, in marshes about tide rivers, where hunters slaughter them in great numbers. The shore birds *(Limicolæ)*, or the snipe, woodcock, phalaropes, sandpipers, plovers and turnstones, include many well-known game birds. Some species of this group breed in Massachusetts, others have their breeding grounds far northward. These birds are more abundant about maritime districts than in the interior, but different species are found inland, in suitable localities, either as summer residents or during migrations.

Grebes, loons, auks, guillemots and puffins, or the diving birds, subsist almost exclusively on fish. Their flesh, dark-colored, tough and "fishy," is seldom eaten; the feathers, however, of some of these divers, particularly the showy coverings of the grebes and loons, are largely used for millinery purposes, and also for the manufacture of muffs, etc.

The jaegers, gulls and terns are mainly piscivorous in habits. The jaegers have been truly termed marine raptores. The parasitic jaeger obtains his living, we are informed by reliable writers, chiefly by pursuing the terns and smaller gulls, and compelling them to disgorge the food they have captured. Some gulls and terns (especially the latter) prey to a limited extent on different kinds of insects, such as large beetles, grasshoppers, etc. Certain of these birds are also good scavengers, and may be seen in harbors or on the rivers feeding on almost any kind of animal matter which is floating on the water's surface. The beautiful plumage of the smaller gulls and terns unfortunately finds a ready market for the ornamentation of lovely woman's head-dress, and as a natural consequence thousands of these harmless birds are slain every year along the sea-coasts. Gulls and terns are gregarious, not only during migrations, but also when breeding. Some species assemble in large companies to rear their young. At certain breeding places along the Atlantic coast, men and boys, known as "egg-hunters," make a business of collecting the eggs of these birds for table purposes. The young of a few species of gulls and several of the terns are said to be equally as palatable as a snipe or woodcock.

The petrels inhabit the high seas, and subsist, it is stated, exclusively on different forms of marine animal life.

Cormorants inhabit both fresh and salt water. They are most proficient divers, and they swim with all the ease and grace of a duck. Their food consists almost entirely of fish, which they pursue and catch when swimming beneath the water's surface.

Ducks, geese and swans are by far the most important of all aquatic birds. The mergansers or fishing ducks, and certain sea ducks, subsist almost wholly on a diet of fish and other marine animal life, which renders their flesh

unpalatable. With a few exceptions, the species other than the mergansers, which frequent fresh water, feed largely on a vegetable diet, consisting of the seeds of various weeds and grasses, the tender blades of grasses, or the stems and roots of different aquatic plants. The flesh of the seed and plant-eating ducks is of course palatable. Herons, bitterns and egrets, although found along the sea-coast, are more numerous about ponds, lakes, swamps and water courses, in the interior. These birds devour fish, frogs, snakes, crayfish and lizards, also sometimes small birds and mammals, and they likewise eat different kinds of insects. Rails, coots and gallinules feed largely on different forms of insect life, and they also obtain a large part of their sustenance from the seeds and tender shoots of divers weeds and grasses which grow in abundance in their swampy and boggy resorts.

Although a few of the shore birds feed to a limited extent on seeds, grasses, and the roots and stems of other water plants, their dietary is mainly made up of numerous kinds of insect life. Most of these birds are found about the sea-coasts or along the shores of rivers, lakes and ponds.

The Bartramian sandpiper, or upland plover, as it is generally called by hunters, and the golden and black-bellied plovers, feed occasionally on berries.

### *Land Birds.*

Of one hundred and ninety species of land birds attributed to this State, it is said one hundred and twenty breed here. About thirty species of the raptores, or the eagles, hawks and owls, are recorded as occurring in Massachusetts as residents, and transitory sojourners. The sparrow hawk rears his young in the hollow limbs of trees, selecting usually the deserted holes of woodpeckers; the marsh hawk nests on the ground in swampy places, but the other members of the hawk tribe generally build rude nests of sticks, twigs, bark, etc., on high trees in the forest, or deposit their eggs on rocky ledges. Most species of owls nidificate in holes in trees or in the deserted nests of crows and hawks. The short-eared owl, like the snowy owl, a native of the far north, nests on the ground.

Following is the list of the birds of prey reported to be most numerous in this State: —

Red-tailed hawk (*Buteo borealis*). Resident.

Red-shouldered hawk (*Buteo lineatus*). Resident.

Broad-winged hawk (*Buteo latissimus*). Summer resident.

Sparrow hawk (*Falco sparverius*). Tolerably common resident, but more frequently met with in the spring and fall.

Pigeon hawk (*Falco columbarius*). Rather rare; spring, fall and winter.

Marsh hawk (*Circus Hudsonius*). Summer resident.

Cooper's hawk (*Accipiter Cooperii*). Summer resident; occasionally found in winter.

Sharp-shinned hawk (*Accipiter velox*). Summer resident; not common in winter.

Rough-legged hawk (*Archibuteo lagopus Sancti Johannis*). Winter resident; occurs generally in meadows and marshes.

Great horned owl (*Bubo Virginianus*). Resident.

Barred owl (*Syrnium nebulosum*). Resident.

Long-eared owl (*Asio Wilsonianus*). Resident.

Short-eared owl (*Asio accipitrinus*). Resident; most numerous in winter.

Screech owl (*Megascops asio*). Resident.

Of this list, all the species, other than the cooper's, sharp-shinned and pigeon hawks, and the great horned owl, and perhaps the barred, which prey considerably upon poultry, different kinds of game and various species of small wild birds, are beneficial, and should be protected by the farmer and fruit grower. With the exceptions just noted, the birds named in the foregoing list feed mainly on mice, and other small quadrupeds and insects, which are so destructive in the fields, orchards and gardens.

The rough-legged, marsh and red-tailed hawks feed chiefly on meadow mice; the red-shouldered hawk, in addition to feeding on mice, devours grasshoppers, crickets and beetles, and he also frequently catches frogs and lizards, and occasionally, like the red-tailed hawk, he preys on snakes. The beautiful little sparrow hawk, the smallest of all our falcons, subsists principally on a diet of grasshoppers and beetles; he is also a good mouser, and, since the pestiferous English sparrows have become so abundant, he has been observed to frequently prey upon them.

The great horned owl feeds to a small extent on different kinds of insects, but his destruction of poultry, game birds and mammals, and various species of small wild birds, is such that the injury he commits is greater than the benefit he confers. The barred owl is also regarded with disfavor by many poultrymen and farmers, because of his occasional visits to the farm-yard. The other small owls are beneficial, subsisting as they do principally on destructive rodents and noxious insects.

*Woodpeckers.*

The hairy and downy woodpeckers are improperly termed, almost universally, by farmers, fruit growers and sportsmen, "sapsuckers." The flicker is called, by many, high-holder and golden-wing. Although woodpeckers make no efforts to build nests as other birds generally do, they nevertheless prepare with great care and labor equally suitable receptacles for their eggs and young. Woodpeckers lay their eggs, which are white, and usually number from four to six, on chips and bits of rotten wood in cavities which they excavate with their powerful and chisel-like or wedge-shaped bills, in the dead limbs or trunks of trees. These holes or nesting-places — oftentimes dug to a considerable depth — at the mouth are often just sufficiently large to permit the birds to pass in and out; from the entrance downward the diameter of these wooden burrows increases in size. The tongue of all woodpeckers found in this region, with one exception, viz., the yellow-bellied, is capable of being protruded beyond the point of the bill to a considerable extent. The cornua or horns of the tongue, extending backward, curl up over the back of the skull; these horns are enveloped in muscles by the action of which the tongue is thrust out. This singular arrangement can easily be demonstrated by simply taking hold of the end of the tongue of a flicker, we will say, and, as you move it backward and forward, place the finger on the top of the bird's head, and at once a peculiar, worm-like movement will be discovered as the horns run back and forth between the skin and bony covering of the head, beneath the finger. The end of the tongue in woodpeckers, other than the species above mentioned, is

generally furnished on either side with little barbs, very similar in appearance to those found on small fish-hooks. In the yellow-bellied woodpecker the horns of the hyoid bone extend only to the base of the skull, hence the tongue is capable of but little extensibility; in place of the barbs commonly seen, we find the end quite abundantly provided with "bushy filaments." The peculiar structure of their feet and sharp nails enables them, by the additional support of their rigid tail, to ascend the trunks and limbs of trees with singular address and celerity, either in straight or spiral lines. From "Coues' Key to North American Birds" the following extract relative to these birds is taken: "Species are abundant in all the wooded portions of this country, and wherever found are nearly resident; for, although insectivorous, they feed principally upon dormant or at least stationary insects, and therefore need not migrate; they are, moreover, hardy birds. They dig insects and their larvæ out of trees, and are eminently beneficial to the agriculturist and fruit grower. Contrary to prevalent impression, their boring does not seem to injure fruit trees, which may be riddled with holes without harmful results. The number of noxious insects these birds destroy is simply incalculable; what little fruit some of them steal is not to be mentioned in the same connection, and they deserve the good will of all. The birds of the genus *Sphyrapicus* are probably an exception to most of these statements. But woodpeckers also feed largely upon nuts, berries and other fruits; and those which thus vary their fare to the greatest extent are apt to be more or less migratory, like the common red-head, for example. Woodpeckers rarely if ever climb head downward, like nut-hatches, nor are the tarsi applied to their support."

The notes of these birds, uttered when on the wing, likewise when at rest, are loud and unmusical. Woodpeckers, with the exception of the flicker, are not usually observed to alight on the ground. Insects which lie under the bark are readily discovered by the woodpecker, who gives a sharp tap with his bill, and then, placing his head close to the tree, listens attentively to hear the movements of his favorite prey. As soon as he discovers a beetle or grub moving in

its snug retreat, the bark or other covering of the luckless insect is torn away, and the crawling creature is captured.

### *Crows, Jays and Blackbirds.*

The American crow and blue jay, both resident species in Massachusetts, although known to destroy many species of noxious insects, are not regarded with particular favor by naturalists who have carefully studied their habits, or the close-observing farmer who has watched their actions.

Crows and jays are omnivorous; in addition to feeding on numerous kinds of insects, they subsist on small fruits and berries, and destroy the eggs and young of domestic fowls; and they also devour the eggs and young of many species of other wild birds, such as robins, doves, blackbirds, etc.

The crow blackbird (*Quiscalus quiscula æneus*) and the red-winged or swamp blackbird are common summer residents in Massachusetts. The crow blackbird, like the jay and crow, is omnivorous, he devours the eggs and young of other kinds of wild birds; cereals, garden fruits and different berries are also eaten by him. In the late summer and fall months the crow blackbird at times commits serious depredations in the grain fields; but at other seasons of the year, when found here, he subsists chiefly on insects and their larvæ. The red-winged blackbird is not known to disturb the eggs or young of other birds. Red-winged blackbirds during their residence in this locality subsist mainly on an insect bill of fare. In the autumn, when they assemble in flocks, preparatory to migrating southward, they sometimes visit grain fields in the neighborhood of the marshes, and inflict more or less damage.

### *The Sparrow Family.*

Between thirty and forty species of the sparrow family (*Fringillidæ*) occur in Massachusetts, and about twenty are said to breed here. Of this large number the English sparrow is the only species regarded by naturalists as being detrimental to the interests of agriculture. The English or European house sparrow, an abundant resident about buildings, nests in bird boxes, holes in trees or branches of trees, in vines and in various places about houses and other build-

ings. The nest is composed of dried grasses, pieces of string, etc., lined with an abundance of feathers. The dull-whitish eggs, from four to seven in number, are thickly spotted and streaked with different shades of brown. In this locality at least two and probably more broods are reared in a season. The English sparrow, as this species is commonly known throughout the United States, is universally despised by farmers, fruit growers and naturalists, because of its pernicious habits. In the spring it feeds largely on the buds of fruit trees, bushes and vines, chief among which may be mentioned the pear, apple, peach, plum, cherry, currant and grape. Different garden products, such as lettuce, beans, peas, cabbage, berries, pears, apples and grapes, are greedily fed upon. The sparrow greatly damages the corn crop, tearing open the husks, devouring the tender part of the ear, and exposing the remainder to the ravages of the insects and the atmospherical changes. It alights on fields of wheat, oats and barley, consuming a large quantity, and, by swaying to and fro on the tender stalks and flapping its wings, showers the remainder on the ground. In addition to a much-varied vegetable diet, the sparrow has been known to kill and devour the young of other small birds. Our native song and insectivorous birds, viz., the robin, bluebird, wren, chippy, song sparrow, red-eyed vireo and some few others, which were formerly plentiful residents in our lawns, parks and gardens, have rapidly and steadily diminished since the hosts of pugnacious sparrows have appeared. This species is more or less gregarious at all seasons of the year. When not engaged in rearing their young, they are always observed in flocks. In the late summer and autumn they assemble in flocks of hundreds, and daily repair to the wheat and corn fields in the vicinity of cities and towns, where they commit serious depredations that are only checked by harvesting the crops.

The white-throated and white-crowned sparrows, the crimson finch, pine and rose-breasted grosbeaks, and the two species of cross-bills, feed to a considerable extent on the buds and blossoms of different trees and bushes; they also devour numerous kinds of insects. At times other than

when breeding, the members of the sparrow tribe, with a few exceptions, subsist chiefly on the seeds of various weeds and grasses. The beautiful rose-breasted grosbeak, found here as a summer resident, is the only species of our feathered friends which has been reported to feed to any considerable extent on the Colorado potato beetle.

*Bounty or Scalp Acts.*

In different parts of the United States, farmers, sportsmen and some naturalists have urged upon their legislators the importance of passing Acts of Assembly awarding premiums for the destruction of certain alleged noxious birds and mammals. These efforts have in certain instances resulted in the enactment of laws which have resulted in the expenditure of large sums of money, and the killing of thousands of animals beneficial to the farmer and horticulturist. Early in 1887 the Territory of Montana offered a bounty of ten cents each on prairie dogs, and five cents each on ground squirrels. The act went into effect March 5, 1887, and the bounties paid during the next six months amounted to more than fifty thousand dollars. On Sept. 12, 1887, the record of payments stood as follows: —

| | |
|---|---|
| 153,709 prairie dogs, at ten cents each, . . . | $15,370 90 |
| 698,971 ground squirrels, at five cents each, . . | 34,948 55 |
| Total, . . . . . . . . . | $50,319 45 |

"It is stated that up to this time the number of prairie dogs and ground squirrels killed had had no perceptible effect on their abundance in the Territory; and, as the money in the treasury was exhausted, the governor, with the permission of the president, called a special session of the Legislature, and the act was repealed." (Barrows' Report, Bulletin No. 1, United States Department of Agriculture, 1889.)

During the session of 1885 the Legislature of Pennsylvania passed an act known commonly as the "Scalp Act," by which bounties ranging from fifty cents to two dollars each were paid by the treasurers of the counties in which the animals were found, for destruction of the heads and ears of the fol-

lowing birds and mammals: hawks, owls, other than the saw-whet (*Nyctea acadica*), foxes, minks, weasels and wild cats. Wild cats were paid for at the rate of two dollars each, foxes commanded one dollar a head, and the remainder of the animals specified in the law were worth each fifty cents.

Under this act, within a period of about one year, Pennsylvania paid probably not less than one hundred and fifty thousand dollars for the destruction of birds and mammals. Of this large sum of money, more than one-half — nearly eighty thousand dollars, as near as we can learn — was paid for the killing of hawks and owls, the greater part of which were species that fed principally on mice and different kinds of destructive insects. It was impossible to learn, positively, the exact number of hawks and owls slain by the provisions of the act of 1885, as some officers in the Keystone State were imposed upon in various ways by the "scalp hunters" In several counties premiums were awarded for night-hawks (*Chordeiles Virginianus*) Bounties were also given for the heads of common domestic fowls, partridges (*Bonasa umbellus*), cuckoos and butcher-birds; and, strange as it may seem to many of you, I was shown by the late Prof. S. F. Baird, of the Smithsonian Institution, the heads of two English sparrows, on which premiums had been paid by officers who believed them to be the heads of blood-thirsty, fowl-devouring hawks or owls. Impositions were also practiced in other ways. In one county upwards of two thousand dollars were paid to a party of hunters (three or five in number) for a mule's skin and a buffalo robe, which were cut into pieces and "fixed up" so that they passed for the "heads" or "ears" of predatory mammals, or possibly the wise (?) magistrate accepted a portion of them as the heads of hawks and owls. A red fox was slain in one of the mountainous districts, and its pelt was cut into sixty-one parts, from which, it is stated, the enterprising hunters realized sixty-one dollars for their work. Birds of prey, as well as other animals on which bounties were allowed, were shipped to Pennsylvania from neighboring States; in this way large amounts of money were fraudulently obtained. Crawford County, one of our western districts, joining the

State of Ohio, paid over ten thousand dollars, and of this sum, it is said, about seven thousand dollars were paid for hawk and owl heads.

Early in 1886, or as soon as our people became aware of the workings and effect of the law, much dissatisfaction was expressed by farmers and others. Under the direction of the Pennsylvania State Board of Agriculture, I began making a careful study of the food habits of the hawks and owls, and obtained the bodies of over three hundred and fifty of these birds on which bounties had been paid. The contents of the crops and stomachs of these bodies were carefully examined by myself or by Dr. C. Hart Merriam and his assistants of the United States department of agriculture, Washington, D. C., and we found that ninety-five per cent of the food materials of these so-called noxious hawks and owls consisted, not of poultry and game, but of mice, other destructive quadrupeds, grasshoppers and many injurious beetles. This array of evidence being presented, through our State Board, to the Legislature, but little trouble was experienced in securing the repeal of the odious "scalp act" of 1885.

Mr. President, a brief history of the "bounty law" of Pennsylvania has been given at this time, owing to the fact that I have learned since coming here that there is a disposition in some sections of Massachusetts to have a general law passed by which premiums will be given for hawks, owls and certain beneficial mammals, slain in this Commonwealth. In fact, sir, you have in localities of your State local bounty acts which are now in force. From the annual report of the finances of Falmouth, Mass., for the year 1888, I see that fifty-one dollars were given for the killing of a like number of hawks. Legislation of this character is, I assure you, detrimental to the interests of agriculture, and should be opposed by every farmer throughout the whole length and breadth of the Bay State, as well as the country at large. The destructive habits of the English sparrow are so well known that the farmers and fruit growers of Massachusetts, are, I am informed, in favor of having a bounty for its destruction. In my opinion, the passage of such an act would be detrimental to the interests of agriculture. While

it is true that the English sparrow deserves the good-will of no one, and is a bird that should be destroyed, it is unwise for any *one* State to offer a premium for his worthless head. I have no doubt that, if the citizens of Massachusetts allow a bounty act to be passed for the destruction of the sparrow, and persons not familiar with birds are authorized to receive the sparrows slain by hunters, you will find that probably not less than one hundred species of the small wild birds will be killed, because the average sparrow hunter will, doubtless, be unable to distinguish the English sparrow from other kinds of birds which are quite similar in their general appearance. With a few exceptions, every member of the sparrow family *(Fringillidæ)* occurring in this State would most likely be captured; many species of warblers and certain swallows, — birds* which feed almost exclusively on insects, and are of great service to the farmer and fruit grower, — the smaller woodpeckers and fly-catchers, orioles, tanagers, thrushes, wrens, and perhaps many of the smaller kinds of water birds, would be slaughtered and offered for bounty.

The time-piece on the wall indicates that my hour is gone. In conclusion I would say that, if any one of my appreciative audience desires to fully inform himself with regard to the English sparrow and its relations to agriculture, he should obtain a copy of Bulletin No. 1 of the United States department of agriculture, entitled "The English Sparrow in North America." This public document, prepared under the direction of the ornithologist, Dr. C. H. Merriam, by Prof. Walter Barrows, assistant ornithologist, is beyond doubt the finest publication on this subject that has ever been issued.

Allow me, ladies and gentlemen of the Massachusetts State Board of Agriculture, to thank you most cordially for the attentive manner in which you have listened to my remarks.

Mr. Ware. I would be glad if the doctor would settle one question. It is a question among many farmers whether the common crow is a friend or an enemy of the farmer.

* A few species of warblers and the tree swallow occasionally eat different kinds of small wild berries.

Dr. WARREN. Since the days of Audubon and Wilson the common crow has had his friends and enemies among eminent naturalists, but the most recent investigations which have been made by food specialists, particularly by Dr. Merriam of Washington, prove quite conclusively that the common American crow is detrimental to agriculture It is true that the crow feeds on grubs, cut-worms, and at times on field mice, but the number of field mice which the crow destroys is not great. In the spring, when the different species of our native birds begin to build their nests, he destroys large numbers of their young and of their eggs. The crow is also a lover of young poultry and the eggs of our domestic fowls. He loves to visit a corn field. It is a question among some naturalists whether the depredations which he commits in the spring are not counterbalanced by the good he does. In some sections of the country farmers tar their corn, and in that way prevent the crow from feeding upon it. But, in direct reply to the gentleman's question, I will say that the ornithologists who have investigated the crow assert that he is detrimental.

QUESTION. Does the kingbird do any good to the farmer? He is a great lover of bees. Does he give anything in return?

Dr. WARREN. The kingbird is one of the fly-catchers. All the fly-catchers feed to a greater or less extent on bees, but the kingbird is the one which preys to the greatest extent upon the honey-bee. He feeds chiefly, however, upon insects other than the honey-bee. He is a great catcher of flies. The kingbird should be protected by the farmer. The kingbird is a common summer resident in this region. He builds in apple trees and pear trees about our houses.

Secretary SESSIONS. I would like to have you give us, in as few words as possible, the results of your examination of the stomachs of English sparrows.

Dr. WARREN. Professor Everhardt and myself examined the stomach contents of one hundred and fourteen English sparrows captured in the borough of West Chester and vicinity during all the months of the year. Fourteen of those birds were young ones taken from the nest, the others were adult birds. Of this number, five had fed upon insects, the

balance had subsisted on cereals and the buds and blossoms of fruit trees, and on numerous garden products. Now, there is one thing which you will often hear asserted by persons who attempt to defend the English sparrow. They say, "You naturalists will never investigate the food of young birds. Sparrows feed their young exclusively on insects, hence are highly beneficial." Now, I will state that the English sparrow, and in fact all birds, with a few exceptions (we have exceptions to nearly all rules), feed their young on an animal diet. The sparrow is not an exception to this rule. Young English sparrows are fed in part on different forms of insect life, but, as I have already told you, the adult birds not only feed their young, but themselves eat, a vast amount of vegetable matter, and the bird should be destroyed.

Mr. Lynde. Will you tell the audience how long it is since the English sparrow was introduced into this country, and what is the extent of the territory which they now cover?

Dr. Warren. The English sparrow was introduced into this country some twenty or twenty-five years ago, and it is now found in all inhabited portions of the United States. It is also found in Mexico and in Canada, and throughout North America generally.

Mr. Lynde. Can you tell about how many were introduced?

Dr. Warren. I think a dozen, fifteen or twenty. They increase with astonishing rapidity.

Mr. Lynde. And those twenty birds have multiplied to such an extent that they have spread all over North America?

Dr. Warren. Well, to a large extent. Of course these birds were introduced at different times. I think I am correct in saying that some were introduced on the Pacific coast, they were introduced into the Southern States, and into New York and Boston. I know that about twelve were introduced into our State, and they are there by millions at this time. The English sparrow raises at least two broods a year, sometimes three, and each brood consists of five to seven birds. Thus one pair of sparrows will produce in a year from eighteen to twenty birds.

Mr. Lynde. They are grain-eating birds, are they not?

Dr. WARREN. They are all grain-eating. One of the characteristic features of the sparrow, in fact, the chief characteristic, is his heavy, cone-shaped bill. [The speaker held up several birds for the inspection of the audience.] When you see a bill like that on any bird, it shows that he feeds on a grain or seed diet, because that bill is adapted especially to the breaking up of seeds. Now, take a bird that feeds on insects. Here, for instance, is the whippoorwill. This bird feeds exclusively on insects, such as beetles. It has, as you see, a soft bill, and one which will readily bend. It is, strictly speaking, an insectivorous bird. Here is our common barn-swallow. That bird has a bill adapted to feeding on insects. It has not a bill built for the purpose of crushing, as is the bill of the sparrow. Any bird that has a heavy bill is a grain-eating bird.

Mr. LYNDE. You have spoken of poisoning the sparrow. What poison, and what method of use, would you recommend as the most effective?

Dr. WARREN. The department of agriculture, where all sorts of experiments have been made to determine the best poisons to be used, recommend especially arsenic and strychnine. I should prefer strychnine; but Dr. Fisher, of the department of agriculture, says that strychnine is too rapid in its action, and therefore he recommends the use of arsenic. The sparrow is, as perhaps you all know, an exceedingly wary and cautious bird. If you feed them with grain which has been poisoned with strychnine, a few of the birds will eat it, the poison will rapidly take effect; and that will scare the rest away, and they will not come back. Hence Dr. Fisher recommends the use of arsenic; although I believe that these birds prefer the bitter taste of strychnine to a sweet taste such as arsenic has.

Secretary SESSIONS. Perhaps at this stage of the discussion it may be well to read the resolution adopted by the House of Representatives last winter, which was perhaps the cause of our procuring the presence of Dr. Warren here: —

*Resolved*, That the Board of Agriculture of Massachusetts be and they are hereby requested to make inquiry and investigation as to the birds that inhabit the State, and report thereon as to their

character, habit and value as insect destroying and grain and fruit destroying birds, and advise on such legislation as may be necessary for the protection of private and public interests.

Now, if the discussion could take a turn which would help the Board of Agriculture somewhat in making that report, it would be agreeable to the Board, I doubt not.

Mr. Forbush. It has been stated quite frequently by farmers and by others that the kingbird does not eat the working bees, but eats only the drones. Is there any foundation for that statement?

Dr. Warren. The kingbird, as well as other fly-catchers which prey upon the honey-bee, is no respecter of kinds; he preys upon both. I suppose, however, he prefers the drone, as the drone does not have, as the Irishman says, the "hot end." Both have been found in their stomachs.

Mr. David Fiske of Grafton. I have had my fruit destroyed to a considerable extent by red squirrels. I would like to ask if there is any way to get rid of these squirrels. Perhaps the doctor can tell me.

Dr. Warren. In addition to fruit, red squirrels also eat various vegetables and certain cereals. The red squirrel is carnivorous in his taste. It is a fact well known to those of us who have traveled considerably in the woods and noticed the habits of birds and other animals, that the red squirrel will destroy the young as well as the adult of many different kinds of birds when he can catch them. Many naturalists agree that the red squirrel is not an animal that should be protected. My impression from my observation in the woods is, that the red squirrel does as much damage as he confers benefit, probably more. In some States the red squirrel is protected by the laws. If he is not protected by the laws, then the best thing you can do is to kill him.

Mr. J. T. Everett of Leominster. I have been deeply interested in the learned lecture of our friend on the birds. In my young manhood, fifty or sixty years ago, the habit of bird-hunting was very common, and on the old State election day it was a very common practice among the boys and young men to have hunting matches. The crow, for instance, counted ten, and other birds a great deal less, down to one.

The crow was sought and killed very extensively in those hunts, but the common singing birds, like the robin, the bobolink, the blackbird, the red-winged blackbird and others, were not very extensively killed. In the last twenty or twenty-five years these hunts have been given up. As a result, the crows have increased to a very great extent, and most of the common singing birds of New England have almost entirely disappeared; and I am sure, from closely observing the habits of those birds and the habits of the crow, that the crow is largely responsible for their destruction. I regard the crow as a great enemy to the interests of farmers. Do I misstate, brother farmers of Massachusetts, when I say that you do not hear one song bird now where you would hear twenty or thirty, forty years ago? I am sure it is so. I have seen the crow take a young robin from the nest and fly away with it, while the old robins followed him screeching in perfect agony. Not only does he destroy the young birds, but he destroys the eggs. I want to see a bounty offered for the crow, and I would have a bounty that should destroy every one. I would gladly wring the neck of the last crow in New England, and then the singing birds will increase, and our children and grandchildren will know something of the pleasure that we old men experienced in our young life in the songs of the birds.

Mr. Fitch of Hopkinton. It is well known that a large number of our birds have almost disappeared within the last ten or fifteen years, on account of the fashion which has prevailed among our ladies of wearing the wings of birds on their hats. I propose that, instead of spending $100,000 in bounties, we spend about $5,000, and send to Paris, where the fashions are set up six months or a year beforehand, and have the fashion set of wearing the colored wings of the sparrow and the crow. If the ladies would only adopt that fashion, we should have no more trouble.

Secretary Sessions. Before this subject is dropped, I would like it very much if the doctor would give us specifically the names of the birds that he thinks ought not to be protected, and the reason, in a word.

Dr. Warren. The crow, from the evidence given, is a bird that does not merit protection. There are certain

hawks and owls which do not deserve the protection of the farmer or the sportsman. But the great trouble is, if you undertake to particularize certain hawks for the destruction of which a bounty shall be paid, that people will continually destroy hawks that are beneficial. Just here I will say that the insectivorous bird law of Massachusetts is a particularly good one. You have a law that exempts the crow from protection, also the jay, and all hawks and owls. Now, if I were to suggest any change in that law, I would particularize certain hawks that should not be killed. The naturalist will not defend the crow; therefore the man who favors a bounty on crows cannot have his statements successfully refuted. The crow is a bird that is known to almost everyone. No man is so dull that he need allow himself to be imposed upon, if a bird is brought to him for identification as a crow that is not a crow in fact. If your people favor it, you can offer a bounty on the crow; but I think you will find that Massachusetts will get thousands and thousands of crows from the States around her.

Mr. Everett. That would be a blessing. Kill them all.

Dr. Warren. Well, if Massachusetts is willing to pay thousands of dollars for the crows within her own borders, and thousands of dollars for crows from other places, she can do so. If you could get national legislation, perhaps that might be effective. I think there is one clause in your law which is too stringent. I believe that clause is antagonistic to the interests of science. Only the Boston Natural History Society, or perhaps the president of that society, and the game commissioners, are authorized to give to individuals permission to collect birds. The naturalists with whom I have conferred tell me that the Boston Natural History Society refuses point-blank to grant certificates, and that the game commissioners are disposed to grant only a very few, and they require from the person who applies to them, a full list of all the specimens of birds and eggs that he has taken. In other words, they require so much that few men will apply to them; and thousands of people, instead of going and getting permits, just go out and shoot birds at random and collect their eggs. It seems to me that it would be well to allow permits to be granted by the

president of the State Agricultural College, or by the secretary of the State Board of Agriculture. In that way you could select people who would not abuse the rights granted them. In that way you would perhaps stimulate an interest in ornithology which might otherwise be suppressed. Some of you may have boys who take an interest in ornithology, and have no inclination to work in any other direction. Now, if a boy is inclined to work in ornithology or any other branch of natural history, is a careful boy, and will spend his time in the study of the birds of his particular region, it is a shame to stop that boy, and not allow him to investigate. He may become an eminent naturalist. Therefore, I think that I would change the law so that there will not be so much difficulty in obtaining permits. Of course I personally know nothing about this trouble which naturalists have; I only get it second-hand.

Mr. BANCROFT of Chesterfield. We have certainly had an exceedingly interesting and instructive address this afternoon, and I wish to move that this Board extend a cordial vote of thanks to Dr. Warren.

The motion was seconded by Mr. Everett, and unanimously carried.

Mr. KINGSBURY of Spencer. I would like to inquire of the doctor what would be the result if the English sparrows ate grain that was soaked in a strong solution of salt and water? Would it injure them, or not?

Dr. WARREN. I do not know that any experiments have been made in that line. I cannot answer that question.

Mr. KINGSBURY. I have seen it recommended as a method of destroying the English sparrow. I know that some birds will be destroyed by eating salt.

Dr. WARREN. I do not know. It is said the mocking-bird will be destroyed by eating salt; but I know a gentleman who fed a mocking-bird with food heavily salted, and it did not affect the bird. But how salt would affect the English sparrow, I am unable to say.

Mr. J. D. EATON. Will the gentleman give the peculiarities of the snowy owl, which is one of the largest species?

Dr. WARREN. The snowy owl is a resident of the arctic regions. This bird differs from most owls, in the fact that

it nests on the ground. Owls as a rule build in holes in trees, or in the deserted nests of other birds. The snowy owl occurs in Massachusetts or in the United States only as a winter resident. Sometimes this bird is abundant in different parts of the United States in the winter, especially in the more northern parts. They have been found as far South as Long Island during excessively severe winters, in flocks of considerable numbers, — fifteen or twenty. The snowy owl feeds on rabbits, hares, and a species of grouse somewhat similar to the common partridge. The snowy owl is one of the destructive owls. He preys occasionally on mice and occasionally on other noxious rodents; but these birds are found in such small numbers in this country that it is not worth while to urge their destruction. In fact, their market value is such that it is not necessary. The specimen I have here is considerably marked with black. The full-plumaged adult male is almost entirely white. I have seen a specimen which was black only on the top of the head and the tip of the wing. Pure white specimens are, however, exceedingly rare.

Mr. W. H. Bowker. I think the doctor in his remarks with reference to teaching boys has struck upon a very important branch of this discussion. My farm was overrun this last summer with woodchucks. I offered twenty-five cents for old woodchucks and ten cents for young ones, and I gave it not only to my own boy but to five or six boys in the neighborhood. The result was that I got any number of woodchucks. Some of them I presume came from my neighbors' premises, but it encouraged the boys a great deal. Next summer I propose to get my boy an air rifle, and teach him to use it in shooting sparrows. I have a friend in Boston who amuses himself in the winter time by shooting them, and he gathers large numbers of them. I think this Board ought to recommend to the State Board of Education that they teach our children in the public schools, especially in the country districts, something that is practical in reference to natural history. I think that we ought to have a little museum connected with every country school, that shall contain the eggs of the common birds, and and that shall also contain specimens of sparrows and other

birds which we want to exterminate, and also birds which we want to preserve, so that they shall be taught what birds to kill and what not to kill. A few lessons of that kind given every year would excite an interest, and I think be the means of exterminating obnoxious birds and animals, and preserving those which it is advantageous to preserve.

Mr. NATHAN EDSON of Barnstable. I would like to ask the doctor if he can give us some good plan by which we can exterminate the crow with poison.

Dr. WARREN. I have never had any opportunity for extended experience in destroying crows with poisons; but I know it is a common custom in different parts of Pennsylvania in the spring for farmers to destroy crows by taking an egg, breaking the shell at one end, and dropping into the orifice some strychnine. I have known a single egg treated in this way to kill three crows. In this case the egg was put on top of a stone in a field three hundred yards away from the house, and in less than three-quarters of an hour I saw three crows visit it, and they all died inside of an hour after the egg was placed there. In winter, when the crows come in large flocks to some favorite roosting place, you might poison them in this way if it was not cold enough to freeze the eggs.

Mr. J. H. ROWLEY of Egremont. I would like to inquire if our crows are migratory.

Dr. WARREN. The crow is a resident bird; that is, a bird that is found in a given locality during every month of the year. If food is abundant on a particular farm, the crows will live on that farm the year round; if food is scarce, then necessity compels them to go elsewhere in order to find it.

Mr. FITCH. I simply want to say one word in support of the suggestion of my friend Bowker. I had occasion to go into a certain high school some few months ago, and I thought I would take with me something that I might use. As I went along I picked a few leaves of the red oak and white oak, a few leaves from an apple tree, and perhaps half a dozen other kinds. After I had been in the school a little while, and had heard a recitation wherein certain of the pupils named certain of the stars, — Regulus, Arcturus, Aldebaran, and so on, — I took out a few leaves, held them

up, and asked how many could tell me the names of the trees that those leaves came from. Nobody answered. I said, "Can any of you tell me?" Several of the boys called out the name of a school-mate, and said "Give them to him." I handed that boy a bunch of the leaves, and he named every one of them correctly. I believe he was the only boy in that school who could do it. At another time I took four grains in my hand. They were the common grains that we raise, — wheat, rye, oats and barley. I gave them to a certain number of boys, but not one of them could tell the different kinds. A few could tell one or two of the kinds, but not one could tell all of them. You are teaching the boys and girls in your high schools all over the State so they can tell you the difference between the *gerund* and *gerundive* in Latin every time, can give a free translation of a line of Virgil, and go through every change in the grammar; but take up a leaf and ask them whether that leaf came from an apple tree or an oak tree, and they cannot tell you. They do not know half as much about that as they do about Greek. Are we teaching the children in our schools as we ought to?

The following preamble and resolution was introduced: —

*Whereas*, It has been clearly demonstrated, by post-mortem dissection and field observation, that most of the hawks and owls are highly beneficial to the farmer and fruit grower, we, members of the Massachusetts State Board of Agriculture and farmers assembled at Worcester, Dec. 2, 1890, —

*Resolve*, That, in our opinion, the birds of prey, or the hawks and owls, with rare exceptions, are of great benefit to the farmer and fruit grower, and should be protected. We respectfully urge our legislators to refrain from the passage of any law which will have for its object the destruction of these birds.

This resolution was unanimously accepted, and adopted.

The CHAIRMAN. There are some questions in the question box that will perhaps bring out discussion on some points of interest which are not very dissimilar to the one on which we have been engaged.

Secretary SESSIONS. I find this question in the box: "What is the prospect for success in the campaign against

the gypsy moth?" Mr. Rawson, I think, can answer that question better than any one else.

Mr. W. W. Rawson of Arlington. It is rather early in the day to answer that question, as the commission have had only the experience of a part of one season. When the commissioners were appointed last March, only one of them had had any experience with the gypsy moth. We have gone on experimenting this season so far, and are at work at present destroying the eggs as fast as possible. The eggs are in secluded places, under the eaves of houses, in holes in old rotten trees, and underneath the branches. We have now about forty men at work hunting them out and destroying them. From about the first of May until the first of August we had something over a hundred men, spraying the trees and killing the creatures in that way. The result has been that none of the trees have had the leaves eaten off of them as they had in the preceding seasons. We took as the basis of our experiments the experience of the Agricultural Experiment Station at Amherst, or of the professors there, in spraying trees with Paris green. We asked and secured, as many of you know, an appropriation of $50,000. We shall have expended at the end of the year about $30,000 of that appropriation. I do not think we shall require so large an appropriation another season. We have thoroughly investigated the outskirts, and find only one case where they have gone beyond the limits of our first investigation. The territory that is now covered is about twelve miles long and four miles wide. When we asked for the first appropriation of $25,000, we supposed the moth infested a territory only four miles long and half a mile wide. I think that in the course of four or five years, if the State will allow us to go on, we can entirely exterminate the gypsy moth. But it is a continual battle all the year through. There are four stages in which these creatures are found at different seasons of the year, and we have had to use different methods of destruction for them in each of these stages.

The Chairman. This gypsy moth is something that many of us do not know anything about. We do not know how it came to be here. Does it attack all kinds of trees, or only certain trees?

Mr. Rawson. They attack nearly all trees, although they are more common on apple trees. They will go into any kind of a tree that has got a hole in it, and lay their eggs in the hole, and we cannot get at them until they come out in the spring. We are stopping the holes up at the present time with cement. The gypsy moths came from Germany nineteen years ago. The gentleman who brought them over thought he might improve the silk worm by cross breeding with this creature. He did not succeed, and they escaped from him. That was in the eastern part of Medford, and the territory near where he lived has been entirely stripped of leaves for the last four or five years. A gentleman who lived in the next house to the man who brought the gypsy moths here told me that he had not had a leaf on his trees for five years past, but this year his trees were covered with leaves, and bore a fair crop of fruit. We sprayed his trees three times.

The Chairman. Will Mr. Rawson describe the gypsy moths, so that we can know them when they are in our midst?

Mr. Rawson. The caterpillar is about two inches long, and half an inch thick when it attains to its full size. It has a brown color, with five red spots on the spine of the back, and it has sixteen feet or legs. They crawl something like the canker-worm, only they do not arch their backs up quite so much. The female moth is light colored, the male is a dark brown and has two horns. The females only live from twelve to twenty-four hours after they come out from the shell. They do not fly about, but lay their eggs and then die. The males fly and seek the females. The eggs are just about as large as the head of a pin. There are from three to five hundred of them in every nest.

Question. What is the size of the moth that does the mischief?

Mr. Rawson. The caterpillar is the one that does the eating. The moth does not eat at all. I should say the size of the moth was about an inch long, and when the wings are spread out it is about an inch and a half across.

Mr. Fitch. When are the eggs laid?

Mr. Rawson. The eggs are laid probably from the 20th of July to the 1st of September.

Mr. Fitch. How long before they hatch?

Mr. Rawson. They will hatch as soon as the weather gets warm enough the next spring. The first day of May is the earliest time, so far as we have been able to ascertain.

Mr. Fitch. How long before they go into the chrysalis form?

Mr. Rawson. They begin about the 20th of June, and continue from that time until about the 20th of July. They come out in the form of moths in about one month.

Mr. Fitch. Then we are to look for them from the first of May until the 20th of June as caterpillars?

Mr. Rawson. Yes, sir. We shall make quite an extended report, which will be published, and which any one can get by going or sending to the State House. This report will explain the work from beginning to end, as far as we have gone. The commission commenced their work the eighteenth day of March, and we met every day from that time until the 1st of August. It required a great deal more work than we expected.

Secretary Sessions. It seems to me that this question of the gypsy moth is a serious one, and ought not to be clouded by any ridicule that may be cast upon it by interested parties or by those who have no interest in the question. It is a question either of stamping out this moth or allowing it to spread over the State of Massachusetts and the whole country. The consequence of its spreading over the country will be that every man who has a fruit tree and desires fruit will get it only at the end of a hard contest with the gypsy moth, just as we raise potatoes now at the end of a contest with the potato bug; only this will be worse than that, because the gypsy moth eats almost anything in the shape of a leaf.

Now, it may be said that the commissioners have wasted money. I do not doubt that there has been a great deal of money spent that the commissioners, if they had known by experience how to do the work when it was committed to them, would not have spent; but, as the chairman of the commission has said, the work was entirely experimental at

the beginning; they had no guide whatever to go by, and the only thing the commissioners could do was to fight the moths as best they could. When they were discovered in this limited territory to which reference has been made, it was believed by the friends of agriculture and by naturalists that it was possible to stamp them out and save the enormous expenditure of money which would be required to keep them in check if they were allowed to spread over the country.

Now, what I desire to have impressed upon you as members of the Board of Agriculture and as farmers of Massachusetts, is the fact that, although the whole of this $30,000 which has been expended has not, perhaps, been spent in the wisest and most judicious way, or as it would have been spent if the commissioners could have been guided in their work by the experience of others, yet, as the chairman of the commission has told you, they have learned a good deal about the habits of these moths, they have prevented their spreading over any more ground, and are now in a position to fight them more effectively next year than they have done this. I hope the sentiment of the community will be made manifest to the Legislature, that we want the campaign continued, and want it continued in the best possible manner. This is a big fight; it is no holiday affair. If this moth gets away from us, the whole country must suffer. There is nothing gained by attempting to disguise that fact. I spoke of the work of the commission having been experimental. I understand their largest expenditure has been caused by spraying the trees with Paris green. They gathered from the experience of the different experiment stations in the country the fact that Paris green applied in this way had proved effectual in the destruction of all leaf-eating insects upon which it had been tried. It had not been tried upon the gypsy moth; but they had reason to believe, and they were advised by entomologists, that in all probability the same treatment would kill these caterpillars. Now, there are those who claim that that has not been effectual. There are some who ridicule the idea of spraying with Paris green, and say they do not believe it has done any good. Then there are others who say that after the creature has reached

a certain stage they do not believe it will kill him. Now, the commission have had their eyes open, and they are convinced that Paris green does do good in certain stages of the existence of the caterpillar; and they are confident that, if the matter is left in their hands another year, they will be able to do still more effective work. They will not limit their efforts to the use of Paris green, but they will resort to any other method which seems likely to produce the desired result in the destruction of these pests. They adopt the motto of the Irishman in a fight, — "Wherever you see a head, hit it." That is the only way they can do. If they can keep the moth within its present bounds, they believe that, with the help of the investigations of science and of experience, they will soon find a way by which they can exterminate him. It may take a few years, and may cost considerable money; but, if it costs one, two, three or five millions of dollars, it will be money well expended for the State of Massachusetts. I do not believe it will cost anywhere near these sums; but, even if it should, it would be money well expended.

Mr. Rawson. I would like to say, in connection with what the secretary has said, that we have had considerable fun made of us for keeping men upon the road with feather dusters to brush off the tops of wagons and carriages. That was an idea of mine. The commissioners found that certain teams were constantly going through this infested territory and stopping at a certain place, and there they found the gypsy moth. The only place where we have found them, outside of the limits where we first found them, is in the brick yards in North Cambridge, where the brick teams that went to Medford with brick had taken them; and all through the summer we made the owner of every brick team and every manure team provide a canvas cover for his wagon, so that it could be brushed off after passing through the infected district. In that way we have stopped the spread of the moths, and it was the only way we could do it. Of course people found fault, and complained of us. I do not think that we have wasted a great deal of money this year, because, just as soon as we found that we were not using our money judiciously, we

changed our methods. I think next year we shall not spray three times as we did this year. You know it rained most of the time in May, and when we sprayed a tree one day the rain would come the next day and wash it all off, so that we had to spray again. If we could get two weeks without any rain one spraying would be sufficient.

Mr. Fitch. I move that a committee of three be appointed by the chairman and secretary to consider and report to this convention a resolution in regard to the action of this commission.

Mr. Everett. I second the motion.

Mr. Bowker. I would suggest an amendment to the motion, that the committee report upon the advisability of the passage of such a resolution.

Mr. Fitch. I accept the amendment.

The question was put on the motion, as amended, and it was carried.

The chairman announced, as the committee to report upon the advisability of passing a resolution in regard to the action of the gypsy moth commission, the following gentlemen: W. H. Bowker, F. H. Appleton and E. W. Wood.

The committee appointed to consider and report to the convention in regard to the action of the gypsy moth commission, by their chairman submitted the following report: —

Inasmuch as the gypsy moth commission has not yet completed its work or published its first report concerning the same, your committee deem it premature for the Board at this time to officially give expression in any manner touching the character of the work so far performed; but your committee, believing that progress has been made, recommend that the commission be heartily supported and encouraged, and that, if required, further reasonable appropriation should be made by the State for the continued and successful prosecution of the work.

The report of the committee was unanimously accepted and adopted.

Adjourned to 7.30.

## Evening Session.

The meeting was called to order at 7.45.

The Chairman. The Governor, by virtue of his office, is chairman of the State Board of Agriculture. He is with us to-night, and will address you and take charge of the meeting. I have the pleasure of introducing to you Governor Brackett, whom you all know.

### ADDRESS OF GOVERNOR BRACKETT.

Ladies and Gentlemen: — One of the evidences of the importance, in the estimation of the Commonwealth, of the work of the Board of Agriculture, is found in the law which provides that the Governor of the State shall be a member of the Board. Whenever he is present at one of its meetings, it is his province, as has been stated, to preside. I have come here this evening for that purpose rather than to deliver any formal address. It has seemed especially fitting that I should render this service at this time, as the lecture of the evening is to be delivered by the chief magistrate of a sister State. I am very glad to be here to meet him, to greet him, to pay him my respects, and to give him an official welcome to the Commonwealth. This is not the first time he has visited Massachusetts. During the Encampment of the Grand Army of the Republic in Boston last summer he was there, and spoke, I know, greatly to the satisfaction and delight of those who had the good fortune to hear him. I know that you will all be glad to listen to him this evening. The subject of his address, coupled with the fact that he is the editor of a well-known agricultural periodical which is devoted especially to the dairy interests of the country, suggests to me the propriety of a brief allusion, during my few introductory remarks, to the dairy interests of Massachusetts.

The importance of this branch of our agricultural industries is evidenced by the last census, from which it appears that the dairy products of Massachusetts were in value more than twenty-seven per cent of the entire agricultural products of the State. Their value was upwards of thirteen millions of dollars, and I presume that the census of the present year

will show a still larger amount. The importance of an industry of this magnitude certainly entitles it to the consideration and to the fostering care of the State. Whatever can be done for its encouragement, for increasing the sale of its products, for enlarging the receipts of those engaged in it, not only contributes to their prosperity, but adds to the wealth of the Commonwealth. It is entitled to every protection which the government can throw around it. Protection is the object, — I am not now speaking in any partisan sense, — protection is the object for which governments are instituted among men. They are to protect the citizen in his life, in his liberty, in the enjoyment of his civil and political rights, in his industry. By our tariff system we aim to protect the American producer, so that his market shall not be taken away from him by those engaged in similar industries in other countries, who, by reason of their cheaper labor and their different conditions, are enabled to make their goods more cheaply and to sell them at a less price. Upon a like principle it is just and expedient that the government should protect the American farmer, so that his market shall not be taken away from him by those making, not the same goods, but other goods in imitation of them, and which by their resemblance the purchaser is induced to buy because supposing them to be the genuine article instead of the imitation. I therefore believe that the claim of the farmers that parties engaged in manufacturing imitation butter should not be allowed to give to that article either the name or the semblance of butter, is just, and that it should be heeded and complied with by the government of the State. In order to encourage useful inventions, the government protects the inventor by prohibiting other persons from making articles in imitation of that upon which he holds a patent. This is done because it is considered to be good public policy so to do. Now, although butter is not a patented article, although no one has a monopoly of its manufacture, I believe that it is likewise in accordance with sound public policy to protect those engaged in its production, by providing that it shall not be counterfeited, that any article made to serve the same purpose shall have a different name and a distinct appearance, so that the purchaser shall be able

to know what he is buying, and be guarded against fraud and imposition. The word "butter" has a specific meaning. The article which bears that name has a definite and well-known appearance, and has been made from time immemorial; and it is entirely fair and just to insist that any article made as a substitute for it shall be distinguished from it both in name and appearance, so that the consumer may know the one from the other, and make his choice accordingly. If the substitute is as good as that for which it is substituted, or attempted to be substituted, let it stand on its own merits, and not masquerade in the guise of something else. As the poet says that "A rose by any other name would smell as sweet," so oleo by any other color than that of butter would taste as sweet, undoubtedly. Therefore let it appear in its natural hue, and not be dyed into the semblance of butter. Then, if, as its friends claim, it is as good and as healthful, and can be produced at less cost, so that the poor people can buy it and not be at so great expense as they would be in buying real butter, the people can purchase it if they wish to; but in doing so they will act understandingly, and be protected from a deception which is a wrong both to them and to the producer of the real article.

Now, my friends, for these very few among the many reasons which could be given, I believe that the demand for legislation upon this subject which has been made before the Legislature of Massachusetts for a number of years is sound in policy, that it is in the interest of honest dealing, that it is for the benefit of the consumer as well as the producer of butter, that it would enable the competition between the two commodities to be carried on upon a fair basis, and that therefore this legislation is entitled to the support of all good citizens; and I trust the demand will be kept up until it meets with success.

At the annual fairs of the New England Agricultural Society it is customary to set apart one day which is called "Governor's Day," upon which the Governor of Massachusetts and as many of the other governors of the New England States as can be induced to come are present. It was my misfortune last summer not to be here on that occasion, by reason of having made an engagement to attend a county

fair in another part of the Commonwealth, before I knew the days on which the fair here was to be held, which I greatly regretted. Of the evenings devoted to the public winter meeting of the Board of Agriculture, this may perhaps be called "Governor's Evening;" and as Governor of Massachusetts I take great pleasure in presenting to you the Governor of Wisconsin, who not only stands at the head of that great agricultural State of the West, but who is also a practical farmer, and therefore qualified by his experience as well as by his study to speak intelligently and interestingly upon any agricultural topic, — His Excellency Governor Hoard.

## THE DAIRY TEMPERAMENT OF COWS.

AN ILLUSTRATED LECTURE BY GOVERNOR W. D. HOARD OF WISCONSIN.

*(Stenographic report by J. M. W. Yerrinton.)*

Mr. President, Ladies and Gentlemen: — I am very much interested in appearing before you to-night, for the reason that, as the boy said, "I have the old taste in my mouth once more." I have been dealing with the political bullock for about a year, to the exclusion of my more gentle comrade the cow, and I have not fared as well as I used to, which no doubt is for the wise and beneficent purpose of teaching me not to forsake old friends for others. I have been quite interested in listening to what Governor Brackett has said to you upon the deeds of this "wicked and adulterous generation." Verily it is such a generation. "The greed of man stoppeth not short of hell," says Andrew Fuller, and he is right; and in his greed he would not only take himself there, but you and me with him.

The adulteration of foods has become a crying sin in this nation. Two years ago we established a dairy and food commission in Wisconsin, and appointed a commissioner, assistant commissioner and a chemist, whose business it was to proceed to throw some light upon the situation. Let me give you an illustration showing how far this greed has gone. Thirty samples of cream of tartar, taken from the most reputable grocerymen, were analyzed, and twenty-four out of the thirty contained not a trace of cream of tartar. They were composed of gypsum and white clay, and the acid imparted by tartaric acid, nitric acid, and various other sub-

stances. I find that everywhere in this universal land of freedom altogether too much liberty is taken with what men eat; and everybody is justifying it, winking at it, and saying, "Oh, well; let every man's eyes be his chief law; let every man's taste decide for himself." We have not thought how very important this question of the adulteration of butter is. Not only does it affect the purchaser, but the producer has a right to ask the government to protect his business against a competition based on a cheat. Competition fair and square he has no right to ask protection against; but he has a right to be protected against competition based upon a cheat. Out of a thousand pounds of oleo nine hundred and ninety-nine pounds are consumed under the supposition, when it is eaten, that it is butter. The man who makes it knows what it is, the dealer who buys it knows what it is, the boarding-house or hotel keeper knows what it is; but the consumer supposes it to be butter. Men tell you that it is a healthful product. That it is not true; it is not a healthful product. It is almost entirely pure carbon. Its melting point is 105°, and the bodily heat cannot melt it. Natural butter melts at 98°. Artificial butter refuses to melt below 105°, and remains in the stomach, to the severe nervous exhaustion of the person. And yet they tell us it is healthful!

Now, the French food commission investigated this subject, the physicians of France studied it, and they found that wherever they fed this substitute for butter to the patients in their hospitals there was a serious depression of nervous energy — that the patients began to decline. They traced it to the use of artificial butter, and they saw why it should be so. Now, if it is not good for a sick man, proportionally it is not good for a well man. Then, again, the present situation is such that you have no guarantee of the purity of that article, and the wildest fraud conceivable can "have free course, run and be glorified" inside of an oleomargarine tub. There is no law to-day to guarantee its healthfulness. I was creditably informed, a few years since, that one hundred barrels of oil rendered from hogs that had died of hog cholera were traced from Iowa to oleo factories in Chicago. Mr. Sherman, dairy commissioner of Iowa, informed me that he understood the same to be fact. Be that as it may, we should

consider that the consumer of oleo has absolutely no protection either in law or natural conditions against the use of the most deleterious of material. By the aid of chemistry the foulest of fats can be deodorized and rendered agreeable to the taste. Butter always advertises its true condition, and no man has any need to be deceived. Not so with oleomargarine. It is a compound fat, and the law has not established any standard of safety or purity in its construction. All the protection the consumer has is the greed of the manufacturer, and anyone can readily see how little that protection is. I was talking with a friend last week, who said, "We are in a serious strait on this question. How can we make any enactment against this article? How can we say anything against a food product, if people want it?" I said, "You cannot, but let me give you a way out of it. This is simply a question of imitation, and imitation is based on a fraud always." To imitate may be the sincerest of flattery, and it is; but it is always a fraud, and a fraud finds instinctive hostility in all principles of law, and consequently I think the proper thing to do is to compel it to appear in its own color, and not masquerade in the color of real butter. Let it select any color it has a mind to but the butter color. New Hampshire has cut the Gordian knot, and told oleomargarine to parade in pink. The result is that oleo does not parade in pink in New Hampshire. It does not want to be recognized.

I am to speak to you to-night upon "The Dairy Temperament of Cows." Allow me to preface the desultory remarks I shall make by saying that for thirty years I have been a student along certain lines connected with the functions of dairy cattle, and for these thirty years I have been patiently pursuing certain lines of investigation, and collecting data upon almost every point independently of all others; so that on some of the points concerning which I shall speak to you to-night I have data reaching as high as from three to eight thousand in number. About four or five years ago I commenced lecturing in our institutes in the West upon this question, and I made the statement that I believed that all the functions of motherhood were based upon the nervous temperament. I began to see that temperament had a very

wide application to two things: first, to form; and second, to function; that the idea of temperament governed these two with wonderful faithfulness and accuracy. Now, let me illustrate. I want to get this idea into your minds clearly, so that you will not be confused in following me. Temperament, I say, governs form and function. It is so in men. There are certain functions or adaptabilities that men have who possess certain temperaments, and they do not have them if they possess other temperaments. First, there are certain pursuits which may be denominated the pursuits of the nervous temperament. Take the occupations which require a light manipulation of the hand,—music, for instance. Let me ask you if you ever knew in your life a man with a short, pudgy finger to be a skilful piano player? Did you ever know a man to play the violin that had that sort of a finger,—a short, fat, blunt, pudgy shaped finger? "But," you say, "what has that to do with it?" Did you ever know a man with that form of hand to possess what is known as the nervous temperament or the sanguine temperament? On the contrary, have you not always noticed that a man with a hand shaped like that is phlegmatic, has the flesh-producing tendency? There is a tendency in such temperaments to a construction of adipose tissue. You see that temperament shapes the form and that function follows form. This is particularly true with men. You see men following certain lines of pursuit agreeing in the outlines of their forms very largely. What makes the Yankee so universally a mechanic? It is because he is a lean, bony, nervous-temperament man; very few of them are of the phlegmatic or adipose temperament. You may find an exception here and there, but there are exceptions to all rules.

Now, temperament governs form very largely, and function. It is so in animals. The nervous temperament predominates in dairy cattle, in dogs that are bred for speed and scent, in horses that are bred for speed, and in fowls that are bred for fighting. The game-cock is essentially a bird of a nervous temperament; the race-horse is essentially a horse of a nervous temperament; the dairy cow is essentially a cow of a nervous temperament; and the hunting

dog is universally a dog of a nervous temperament. This is peculiarly seen in dogs. I have been a breeder of dogs, and I have been quite a student of them. The bull-dog, the bird-dog, the setter or the pointer, has a construction always agreeing in function with his temperament. The fox-hound the same way. There is something very interesting when you take the physiological basis of these animals, or the physiological basis of all animals, and commence to study function from the basis of temperament, and then deduce from it the laws that should govern you in handling and feeding them. The animal of the nervous temperament requires a different food, seems to have a different order of assimilation. The dairy cow has to be fed differently from a beef animal, if she carries out her function.

Now, these things apply largely, my friends, in our study of the laws of breeding. When we come to breeding, then we are dealing with the physiology of the question, and we are supposed to be "as gods, knowing good from evil." The difficulty with the average cow of Massachusetts and Wisconsin is that she has been bred with scarcely any reference to her temperament and to her purpose. Intelligence has not gone ahead and guided the life that was to come; and, as a consequence, the average farmer has been breeding blindly, — dealing with these wonderfully deep forces, and dealing with them blindly. If there is a man on earth who is God's vicegerent here, it is the breeder, the man to whom God has delegated the power to handle and shape life.

These thoughts—I am only outlining them now a little—have led me to make a special study of dairy cattle for thirty years; and I found, as I began to divide the question upon temperament, the reasons that had produced the animal. I found that, wherever you had a dairy cow of a decided and distinct specialty of purpose and function, you had a cow of agreeing temperament, though she might be of a different breed. Now, here is a Guernsey cow, and there is a Holstein cow. (Referring to the illustrations.) You see in the two cows a peculiar agreement of outline, contour, appearance and expression. Both of them are of decidedly nervous temperament. Now, nervous temperament, as I said, has a remarkable effect upon form. It produces the

lean and bony outline and make-up which we designate as belonging to the nervous temperament. It has a remarkable effect upon the construction of the bones. Look at the picture of a Hereford heifer. She is as thorough a thoroughbred as the Guernsey or Holstein; yet, if you could analyze her bones, you would find them of a totally different make, and varying in a manner highly instructive to you as you put them under the microscope. Let me give you an illustration. Two thousand years ago an old Arab said, "Form is everything to purpose." Now, he had a distinct purpose in his mind in breeding, and that was to produce a horse that would carry his rider over the sand of the Sahara, fetlock deep, twenty miles, and never break his gallop, and then carry him forty miles more. The Arabian horse is not so swift as the thoroughbred English race-horse for a short distance, but he has tremendous staying power. Where does he get it? In the first place, he is rightly built in the bones. At a lecture that I attended some twenty-five years ago, given by an English surgeon, he gave a very fine illustration of the difference of the effect of breeding upon bone. He had two inches of the bone between the gambrel and the fetlock joint of a thoroughbred Kentucky race-horse, and a corresponding piece of bone from a Conestoga draft-horse, weighing nineteen hundred pounds. The appearance of a cross-section of those two bones as I looked at them was full of instruction. The Conestoga draft-horse bone was nearly a third larger than that of the race-horse, yet the race horse bone weighed the most; and the lecturer told me that the bones of that race-horse were stronger when he was in life than any two pieces of steel of similar size that could be forged. I said, "Doctor, can that be possible?" "Yes," said he; "I will prove it to you. His weight was nine hundred and fifty pounds; his average leap was twenty feet; and when in life those two bones sustained the shock of projecting nine hundred and fifty pounds twenty feet at a throw for a mile. Could any two pieces of steel of similar size have endured the strain, had they been put in place of the bones?" Here, my friends, we see the marvelous wisdom that has attended the long line of intellect and judgment from the Arab down to the man who is breeding that horse

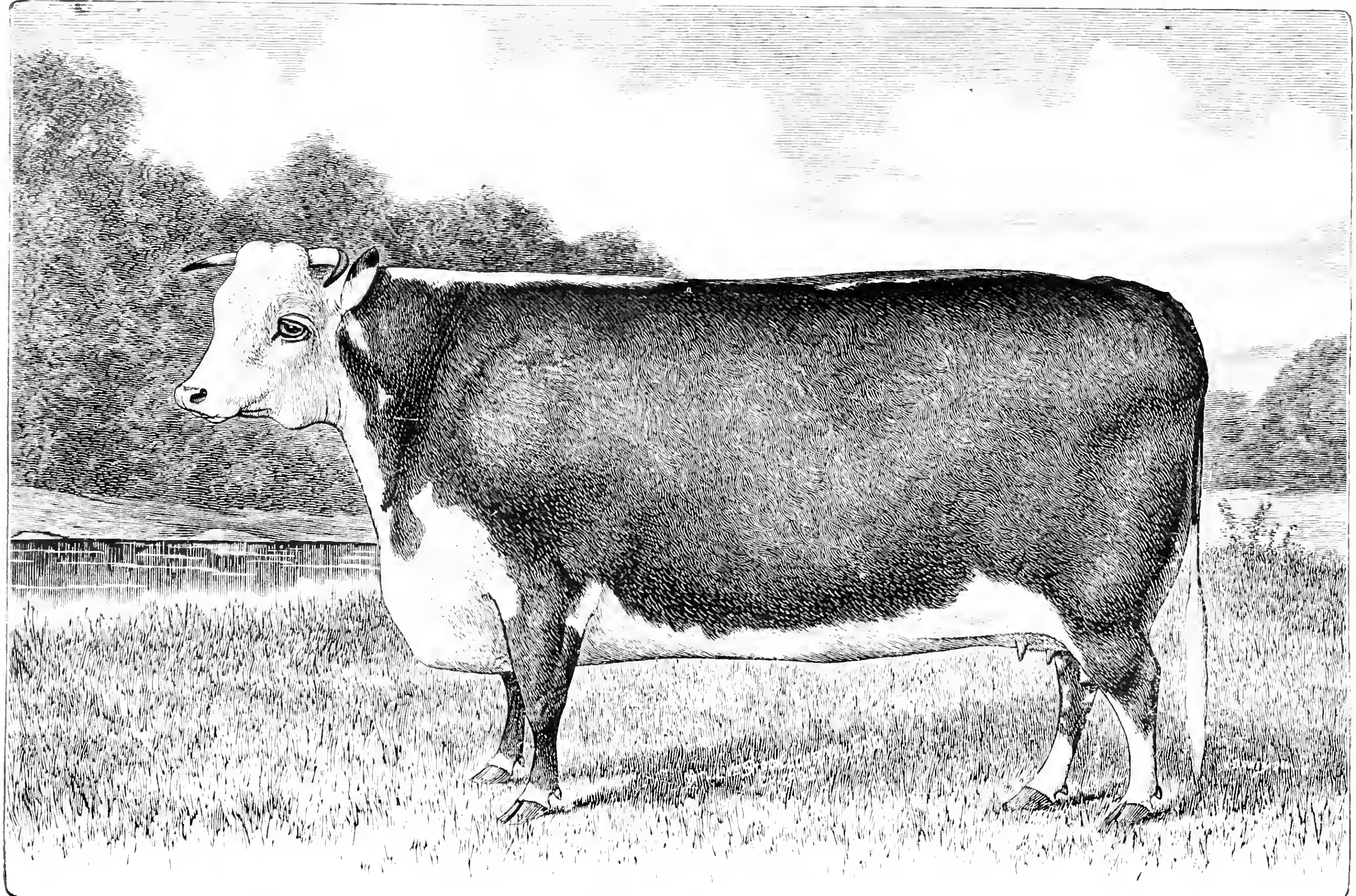
to-day for a specific purpose. They have not been governed by any notions, but have kept within the line and maintained their purpose, and the horse is what he is.

I have said that this distinct effect of breeding on temperament was shown clearly in dogs. (I will come to the cattle pretty soon.) Have you ever, my friends, noticed the effect of breeding in a straight, specific line upon dogs? Take, for instance, the bird-dog, the setter or pointer. He has as sharp a nose as any dog in the world, and a very peculiar, delicate power of scent. Take the fox-hound. He has a nose just as sharp. Wonderfully delicate are his discernings. I have seen one regain a track after twenty-four hours had elapsed, and slowly and carefully, painfully, you might say, work it out. One would not suppose that in the filamentary intelligence of that dog's brain there could come any discernment; but it was there. The wonders of nature are not wrapped up in the form of man altogether. Now, there are those two dogs. One of them has been bred specifically to discern the scent of birds. He will cross a thousand fox tracks, and never know it, — pay no attention whatever to them; but let him range a field in front of you, and the moment that he strikes the track of a bird you see the result of years of breeding in the suddenly arrested pose of that dog. You see him stand and stiffen, and there comes to him the answer of his purpose, — a purpose commenced back hundreds of years ago, and augmented by increasing efforts every year, until he is the product of it to-day. A fox-hound beating over the ground crosses a thousand bird tracks, and never knows it. His power of scent is just as great as that of the bird-dog, but the purpose is different. Suddenly he strikes the track of a fox, and then he lifts his head and exclaims, in the hound's tongue, "Eureka! Eureka!"— "I have found him." "Found what, Mr. Fox-hound?" "Found that for which I was bred, — found a fox track."

Now, what I complain of, my friends, is that the breeders of dairy cattle have not been dealing with these forces one hundredth part as intelligently as has the breeder of the horse, the breeder of the dog, or the breeder of the chicken. Those men have set their eyes upon the purpose which they

wanted to carry out; but the farmer has bred without any specific purpose in his mind, not realizing that his whole salvation depended upon the wisest and most intelligent adjustment of the forces around him, in order to secure success and profit. Now, you know there is not a boy in Massachusetts who would be foolish enough to go out and hunt birds with a fox-hound, or to go out and hunt foxes with a bird-dog, or to hunt either with a bull-dog; but his daddy very likely will be hunting for a butter cow with a beef animal, and then wonder why the tariff does not do better for him than it has done. Why, my dear friends, the waste, the terrible waste of effort which has characterized American agriculture is disheartening, — it is fearfully disheartening. We see it in the West worse than you do. Four years ago there was a very severe drought in Rock County, Wis., and half a million of dollars were spent in buying fodder for the cattle, sheep and horses in that county; and at the same time there was an acre of corn fodder there for every animal there was in it. And those men are saying, "Lo, here is the Christ of our agricultural salvation, over in the tariff!" and "Lo, here, in the Farmers' Alliance!" and "Lo, there!" — "Lo, anywhere," but in the heart and in the head. God said, "By the sweat of thy face" (it is quoted generally "brow") "shalt thou eat thy bread." Now, why did he put the sweat on the brow? He did not put it on the back, he did not put it on the hand, he did not put it anywhere else except on the brow. I think he did that for the purpose of indicating to you and me that if the little machine that lies underneath the brow does not work intelligently, there will be a shortage of bread. I read this between the lines, that the sweating must be below the simple covering of the head, and it is very likely to cause an exudation over the brow.

Now, I have been thinking on this question. I have seen, my friends, — I know it is true in Massachusetts, and it is true all over the United States, — I have seen the destructively low average of our dairy cattle, — destructively low in the sense of destroying our hope and our profit; and men are working upon farms on the hill-sides and in the valleys all over the country, engaged in handling cattle without an



"Venus," by "Lord Wilton."

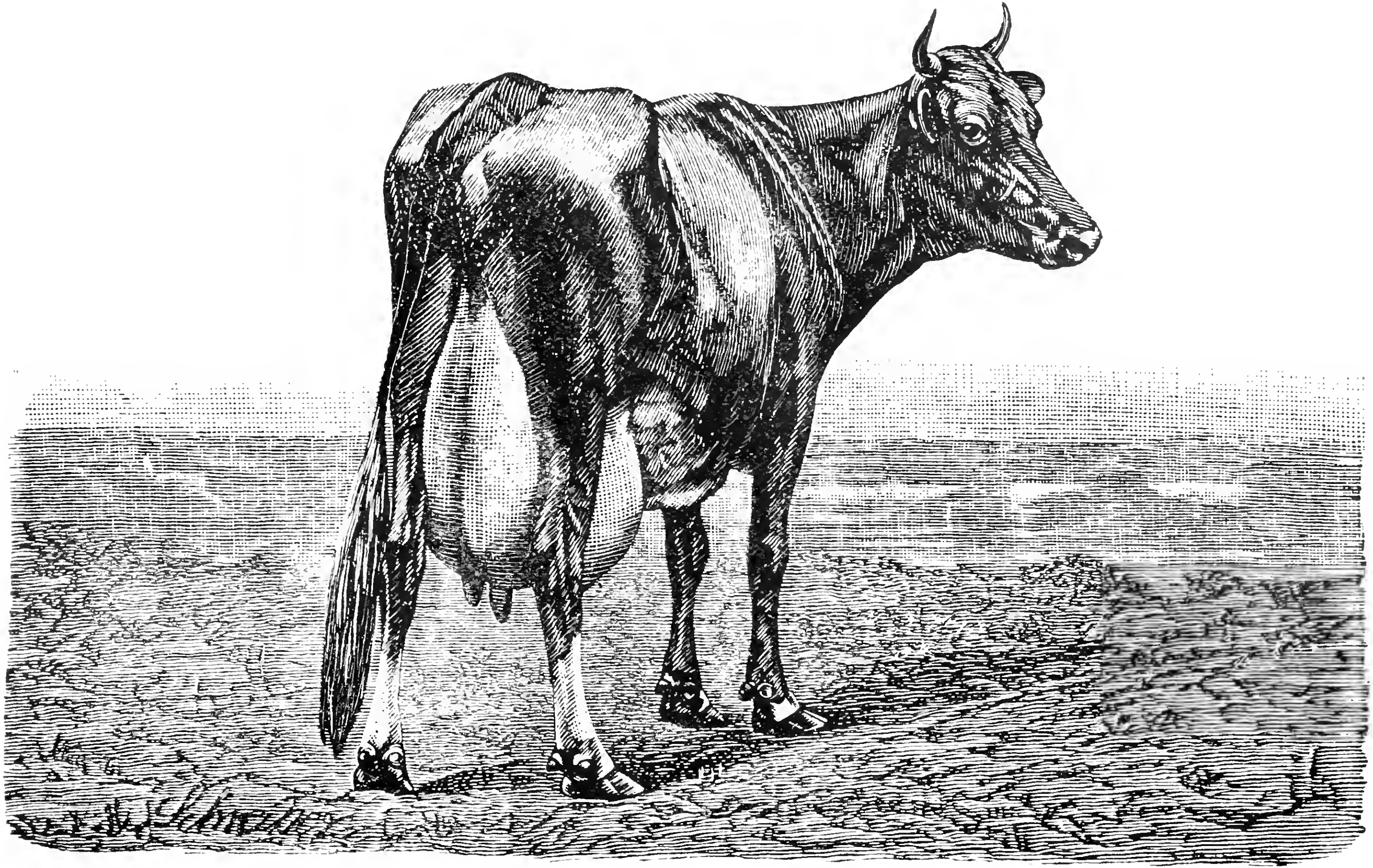
intelligent understanding of the animal physiologically, without knowing what a cow is, how she came to be what she is, or how to handle such a delicate piece of machinery.

You see before you in this picture of a Hereford heifer a clear illustration of an opposing temperament. This animal has been bred for hundreds of years to lay on flesh and fat. She shows, in all of the distinguishing characteristics of her outline, the peculiar form and function of an opposing temperament, and I bring her before you in order to make the contrast more sharp. This animal belongs especially to the phlegmatic or adipose temperament, and just in proportion as you enhance this power do you decrease the power of maternity. Now, what is this Holstein cow? She is the enhanced and enlarged expression of motherhood and maternity. Before motherhood and maternity let every man take off his hat! This Hereford cow is a miser. She constantly gathers to herself, and refuses to give up until she is led to the block. This Holstein cow is a benefactor. Motherhood is always a benefaction. The meaning of it is to give, and give every day. Now, the temperament of the Hereford cow is shown clearly in her form. You see her heavy shoulder, the projecting brisket, the round shoulder-blades, the heavy chine, the heavy loin, the marked outspring of the rib from the backbone. Why? In order that her loin may lie there. In the dairy cow the rib springs the other way. There would be no chance to lay the loin if it sprung that way in the Hereford; it would slip off. Therefore you see how widely varied are the forms of these animals; and when you look deeper you find they differ in their temperament, and the temperament seems to determine their function. If you meddle with that temperament at all, and endeavor to unite the temperament of the one with that of the other, so much the less will the dairy temperament enhance your profit. And this is the reason that you see to-day all over the United States this low average in dairy cattle. What has been the folly that has caused it? The universal idea among farmers of a "general-purpose" cow. "I want a cow," says one, "as a general-purpose cow;" and so he breeds for a little beef, a little milk, a little this and a little that, and in the end finds himself without profit in any line; and as a

consequence the average cow of the United States produces only one hundred and twenty-five pounds of butter a year. According to the United States census, it is less than one hundred pounds a year; but I think I am not far out of the way in putting it at one hundred and twenty-five pounds. And yet there is not a cow to-day in Massachusetts that can be kept for less than one hundred and fifty pounds of butter a year. The man who keeps such a cow is universally in debt for her board.

Now, this Hereford cow gives you this long, straight flank, this heavy ham, Poland-China in its outline; and you will find, if you examine the make-up of this cow with the ends of your fingers, that she is very closely knit, and that the flesh is even. Sometimes you can almost insert your fingers between the muscles of a dairy cow, and that is one of the indications by which you can judge a good cow. You cannot do anything of that kind with this Hereford heifer, because the phlegmatic temperament has caused her to form a different condition of muscle. She is bred for beef. She is a square block, with legs attached to it. She has everything about her that indicates the beef temperament.

Now, let me call your attention to this Guernsey cow, for instance. You see how differently she is made. In the first place, you have a different form of nostril. When you get home, look at your cattle in the light of what I tell you. Take out the best cow you have got, and follow the lines I have given you. You will find that a good cow, a cow with a decidedly dairy temperament, has a large, open nostril, — the same as a good race-horse, the same as a good fox-hound. In all of those three animals there is an agreeing shape in the nostril. The dairy cow must of necessity be a large breather. The milk is elaborated from the blood, and the blood is affected very largely from the lungs; therefore, a good dairy cow should have large breathing apparatus. You see in this Guernsey cow the bony outline of the head; you see how bright and full the eye is. A good cow should show a very large, full eye. Why? Because a full eye is indicative of a decided tendency towards a strong expression of the nervous temperament. A good cow should also show a large development of brain, and that is seen in the length



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between the eyes and the poll. The longer a cow is between the eyes and the poll, as a rule, the better developed is the brain. And I want to say to you, my friends, that maternity has wonderfully to do with the brain; that there is no other function on earth that so exhaustively calls upon the brain and upon the nervous system as the function of maternity; and when you are dealing with the cow you are dealing with the enhanced expression of motherhood or maternity, and therefore you must study this subject from the standpoint of physiology. I regret very much that veterinary science gives us scarcely anything in this line. I have written all over Europe for studies upon this question, and have not been able to find any except studies of the human mother; and the study of her has been very largely contributory to what I have known in this matter.

Now, the neck of a dairy cow should show a strong, firm jointure of the head. In judging of a cow, put your hand back of the horn, and examine to see whether the spine comes up full and strong to the head. If there is a weakness apparent there, you will find that the cow is very likely to fail easily in her work. A dairy cow has a thin neck; the beef animal, the bullock of the feminine gender, has a thick neck. This indicates the difference of their function and the difference of their temperament which lies below. Now, the thin neck is indicative of that femininity that you are searching for, — the enlarged expression of femininity. A dairy cow should show a sharp shoulder. There, again, is the expression of the nervous temperament. Compare a race-horse, for instance, with a draft-horse. A race-horse has a sloping shoulder, thrown right back; the withers are sharp. Did any man ever see a race-horse, that was of large performance, with a mutton shoulder? They are very rare. I have seen an Indian pony before now, I have seen a few horses, that had some ability in that direction; but I never saw a horse that was able to run a mile in 1.40 that had a mutton shoulder. Now, why has the race-horse got this sloping shoulder thrown back? For the very evident purpose of letting out the forward feet. The old Arab, as I told you, said, "Form is everything to purpose." Just so in the dairy cow.

Now, I want to treat of something that is hard to show you, and that is, the spine. When I judge a dairy cow, I always judge as though my money was in my pocket and I was judging for it. When I judge a dairy cow, I pay particular attention to the construction of the back, to the construction of the spine. I want a cow to show a very large, strong, rugged expression of the spine, — large processes; and, if you will study the backbone of noted dairy cows, you will see to your astonishment how much larger is the backbone of such cows than even of oxen. A gentleman who heard me speak on this subject in Canada told me that he was much impressed with what I said, and that he had taken the pains to examine the skeletons of many of the famous cows of that country, which had been preserved, and he had discovered this remarkable development of the back. Now, what is the meaning of it? It means this. The maternal functions draw immensely upon the nervous system, upon all the ganglionic centres, upon the spine and upon the brain. The brain is the source of nervous power. Now, if you have a very small channel in the back for the transmission of nervous energy from the brain, you will find but a limited force for the work of the cow; but you will find that, where the animal is constructed for this purpose, nature takes care of it, and gives her a strong, rugged, full back, and that, as a rule, she throws the back up. You will often find in noted cows that the spine rises above the tops of the shoulder-blades. This cow Tritomia belonged to the Holstein herd of T. B. Wales of Iowa. She was the cow to whom I gave the first premium when acting as judge of three hundred and eight Holsteins at the Minnesota fair. When I came to her, she was in a class of forty-eight cows. I was wonderfully impressed with the expression of power that that cow gave me. I examined her critically, and found that she had evidences of her talent in every direction, and particularly in this expression, the spine rising above the shoulder-blades fully an inch. I gave her the first premium, and there was a decided expression of dissent. Men said, "What is the man thinking of? There are lots of cows here that are handsomer than she is." But I was judging the cow by dairy talent, and dairy talent alone. I said, "Gentlemen, I am


TRITOMIA 4004 H.H.B.
BUTTER RECORD 25 lbs. 8½ oz.

content to leave the result to the test." She was then in the test along with Jerseys and other cows, and the result was to be declared in two days. Very fortunately for me, when the test came off she had distanced the whole of them. Then men came to me, and asked me what I saw in that cow. Now, take the form of expression of the barrel. Observe the inset of the ribs, — how they spring differently in the cow with the dairy temperament from the way in which they spring in the cow with the beef temperament.

We come now to a very important thing in the judgment of a good cow. I want to enlarge upon this, gentlemen, because there is a notion abroad that controverts it. This is the pelvic formation, called by some "the pelvic arch." You see how differently these two types are constructed. The favorite form is the form of the Hereford. All over the world men say, "I want a straight back." Here you have in this Hereford heifer the straight back. This cow has no expression of the power of motherhood. But see how differently this Holstein cow is formed. See this pelvic arch, this low rump. Here lies the expression of maternity. Nature, always true in her expression, has given you a totally different outline in this Holstein from that which you have in the Hereford. The famous Oakes cow which you had here in Massachusetts a number of years ago, that made four hundred pounds of butter a year, had a rump of exactly the same shape as this Holstein cow. As a rule, this outline is always a most excellent thing to see.

Now, another thing is the difference in the formation of the ribs. In the dairy cow you have a different shape from that which you find in the beef cow. This Hereford cow is close-ribbed. The ribs are narrower and closer than they are in the Holstein, which has an open expression. The ribs are wider, and the spaces between them are wider. Now, what is the whole philosophy of that? This Hereford cow has an expression of tight, close growth, form and expression. This Holstein cow is relaxed. We come back again, gentlemen, to motherhood. The conditions of motherhood invariably call for relaxation, and the relaxed expression is here.

Now, I have one point which I wish to treat of here, and

that is, *constitution;* and I want to speak for a moment of my own views of *constitution* in animals and man. We have a very confused idea of *constitution.* You hear plenty of men saying, "I want a cow that is hardy." What do they mean by "hardy"? Why, they mean one that they can neglect; one that they can turn out to the tender mercies of the north wind; one that they can fairly deluge with cold water; one that they can expose to all kinds of ill treatment, and she will stand up and survive. But, if they were wise, they never would ask for a *hardy* cow, they would ask for a cow of strong constitution. What is *constitution?* It is this, gentlemen,—the power to endure to the end within the line and limitation of your purpose. John L. Sullivan has a constitution to stand up before a bruiser and be pounded severely; but if you stood him up before a bank clerk's desk and compelled him to do a bank clerk's work for a month, he would die. His constitution would fail, and you would wonder at it, wouldn't you? Why would his constitution fail? Because John L. Sullivan is not built that way. Now, constitution is always governed first by purpose and by functional adaptation. The constitution in a dairy cow simply means that she has the power to do a dairy cow's work, and survive, — not to do a Texas cow's work. A Texas cow is about the poorest expression of motherhood that I ever saw. I had three hundred of them after me once, and they chased me two miles. No really good cow would ever have done that. If a man is to be judged by the enthusiasm of his following, I was the most popular man ever seen in Texas. Now, the Texas cow has a constitution to endure great straits, — severe northers sweeping off from the mountains down to the plains, short feed, to go without water; but, gentlemen, you get no milk, you get no expression of her purpose. Therefore, constitution must be looked for from other stand-points than the popular notion of hardiness; it must be gauged by the ability, within the close line of the purpose, to endure the work. Now, it is just as necessary to have a strong constitution in a dairy cow as it would be in an Arab horse, in a hunting dog, or in a Texas cow; but it must be of a different kind. Where do you look for it? The very best expression of constitution, gentlemen,

that I have ever seen, the surest, is in the construction of the navel, — the umbilical construction. I first got hold of that idea in seeing a surgeon reject a man for the English army. I saw him turn off a young man, broad-shouldered, full-chested, straight-limbed; and I said, "Doctor, why did you reject that man?" He said, "He has no constitution; he will go down under the work." "How do you determine it, doctor?" He said, "There is no strength about the umbilical expression; the umbilical development is weak." I said, "This is a strange theory, doctor, to me." And allow me to say I do not consider this an indelicate matter, because it is true. You know what the Lord said to Peter: "What God hath cleansed, that call not thou common." When we are dealing with truth, there is no indelicacy in the matter. I said, "Doctor, how is that?" Then he gave me this very interesting theory. He said, "Constitution cannot be fed into a man; it is something his mother gives him." It is that power of endurance, of ability to sustain straits, to endure large purpose and large work, within the limits of one's strength, not outside of them. That is something that is given to the child by the mother, and we can see the machinery through which this is conveyed, — the umbilical machinery or avenue. If that is flaccid and is of weak expression, it is a certain indication, I never saw it fail, that the constitution is weak, no matter how great may be the talent. Now, you are treating of talent here, just the same as you would be of a man, — the power and ability to do. The dairy cow has talent in her line, the statesman in his, the arithmetician in his, the mechanic in his; but the ability to endure the work of that talent is what we call *constitution*. I said, "Doctor, have you ever carried this any further than men in your judgment?" He says, "I have carried it into horses." "How did you find it there?" He was a magnificent judge of a horse, and he showed me very clearly how this umbilical development indicates the strength of constitution and endurance in the horse. I then took up the study of it in dogs, and I never saw it fail with the fox-hound or with the setter or pointer. I carried it still further, and I have three thousand different cases that I have studied and taken the

data of. I have never, gentlemen, seen it fail in a dairy cow. I could show you numerous instances of cows that have gone down under their work, and invariably that expression was wanting. It is also indicative of the power to resist disease. Large vitality is valuable to any form of life; it enables its possessor to resist disease. I lost a most valuable Guernsey cow last spring, of milk-fever. When I bought her, the gentleman who sold her to me pressed me to take her. She was a cow of great talent. I said to him, "Mr. Clapp, she has not constitution, I do not want to take her;" but he said he would almost give her to me if I would take her, and finally nearly made me a present of her. I cared for her with the greatest assiduity and watchfulness, and always what I saw in her had large expression of talent, but a very weak constitution; and finally she died.

The mammary gland is a wonderful piece of machinery. I have never studied anything that seemed to me to be such a maze of difficulties; and yet how indifferently we treat it, how rudely, how foolishly! The formation of the udder is indicative of the talent of the cow, indicative of her purpose, indicative of her ability. It should rise high in the rear, and extend well forward upon the abdomen. Draw a line from the farthest point on the abdomen to the highest point in the rear, and the length of that line will be a measure to you of the power of the udder over the cow, the narrowness of it of the power of the cow over the udder. Now, a narrow udder has but very little power over the purpose of the cow; a long line keeps her busy, keeps her to her work. This mammary gland is enveloped with the most marvelous network of nerves, called "the sympathetic plexus,"—the most wonderful network in all the body. This network completely envelops the mammary gland, and passes from there to the uterus, and from there to the lumbar region of the spine. Now, reflect on the course that milk-fever pursues. Milk-fever is a mysterious disease, but it very clearly illustrates in its reflex action the close connection between the nervous machinery and the mammary function. It is generally preceded by a chill caused by a draught of air, drinking cold water, a sudden fright, or anything which disturbs the nervous action of the system; and instantly, before you

know it, its deadly work has set in. At once it telegraphs down this line of nerves to the udder, "Stop secretion!" and it is obeyed. The inflammation proceeds along this network of nerves to the uterus, to the lumbar region of the spine, and it keeps progressing; and the moment that it reaches the spine, paralysis of these parts ensues, and the cow drops. It is called "dropping" in England. It then commences to involve the spine, and keeps progressing clear along to the brain, convulsions ensue, and by-and-by the poor animal swings her head sidewise, her eyes grow glassy, and she dies, the victim of her own maternity.

Now, my friends, you and I very little understand the wonderful connection between the nervous machinery and the mammary function; if we did understand it better, we would use this gentle mother a great deal better. No finer truth was ever uttered than that expressed by Mr. W. C. White of Wisconsin, a man who illustrated in his person the sweetest elements of human nature, — the most successful dairyman that ever appeared in our State. When asked how he treated his cows, he said, "I always speak to a cow as I would to a lady." A great many men reverse it, and speak to ladies as they would to a cow. But, my friends, the man who is lacking in respect for the motherhood of either does not deserve either.

I said to you that the nervous machinery operates with wonderful force upon the mammary functions. Let me give you some examples. I had a beautiful little Jersey cow that was a great favorite of mine; a cow that was as full of intelligence as anything I ever saw, and she was a great pet. I took her as an experimental cow in my studies along this line. I sat down to milk her one day, and took the milk which flowed during the first few moments of her milking and set it one side; kept on milking, and suddenly took a pin, — I wanted to beg her forgiveness for doing it, but I was after truth, — and gave her a severe scratch across the flank. She had never known such treatment, and she sprang from me, agitated and trembling. I finally quieted her, and drew the rest of the milk from her udder and analyzed that, and also the milk that I had drawn before disturbing her, and I found that I had in an instant eliminated fifteen per

cent of the butter fat. Gentlemen, do you know that the fat of milk is one of the most elusive things in the world? Nervous agitation has the power to almost at once eradicate it. It changes none of the solids of the milk, or scarcely any at all; but at once the fat leaves the milk upon the occurrence of some nervous disturbance, and no one knows where it goes. It will not appear again in the next milking. Dr. Babcock heard me talk on this question several years ago, and he said that it was such a large domain he believed he would commence investigating it, but he says he has got discouraged. He has, however, brought out some valuable facts. He is at our experiment station, and one of the best experimenters in America or anywhere. He has taken cows and put them in the stable and has changed their milkers. Every old dairyman knows how it affects a cow to change her milker. I have seen a cow, for instance, greatly agitated at the sight of a child. I purchased a cow that evidently had never seen a child; she was brought to my stable, and a little child came into the field outside of the yard and looked through the bars, and it nearly frightened the cow out of life. She made frantic efforts to get out of the yard, and I found that that cow would be so disturbed whenever she saw a child that the fat was almost completely eliminated from her milk, and yet she gave as high as five or six per cent of fat in her natural milk.

These things lead me to say this: that a wise student of the cow commences by studying the temperament that she is built on. That is largely a nervous temperament. As you breed, your breeding enhances the power of the nervous temperament of that animal. Now, I want to be understood that when I say "nervous" I do not mean *excitable;* I do not mean *nerveless*, but I mean *nervous;* that is, having nerve power. You say a man is a man of large nerve. What do you mean? Do you mean he is very excitable? No, you mean he is a man of large nervous power. He is a man, however, with a very large and enhanced nervous machinery, and if you carry him to the point of excitability he is much more excited than a man of less nervous power. So it is with the cow. She should be treated kindly and gently, and never allowed to get excited;

but, if she does become excited, by virtue of this large nervous development, she becomes the most excited of any animal of her kind. But people make a mistake in supposing when I speak of this that I am speaking of *excitable* cattle. When I speak of the nervous temperament, I am speaking of cattle which can be made excited, but should not be.

Now, I said to you that the nervous power, the nervous temperament, induces a peculiar form. You can see it in these illustrations before you. It is seen in the contour of the limbs, it is seen in the delicacy of the outline of this dairy cow. She is a great deal more feminine; she is built upon a different temperament. Now, this calls for judgment in handling. The man who would be a successful breeder of dairy cattle must understand that the dairy temperament calls for essential care in handling, calls for essential care in using. Gentlemen, motherhood cannot find its expression if you deny it warmth. Remember that the dairy cow needs much more warmth than the beef cow. She is affected particularly by cold water, by cold draughts. She must have, if she is to give you the most profitable expression of her motherhood, first of all steady care, continued care, and then you must give her warmth. I have seen, for instance, steers on the prairies of Iowa go out of their stable and lie down on a snowbank. Did you ever know a cow that is giving milk to do that? Never. You see her shrink behind the barn or into the sunshine as quickly as possible. You see her seeking warmth always. When I first brought out the idea of warming water for dairy cows, I was greeted with a good deal of ridicule; but I based it upon a principle applying to maternity, and I would say just this one thing, — I wish that every farmer in Massachusetts would consult his wife a great deal more than he does. She could tell him some things that it would be well for him to know concerning the female body.

The dairy temperament calls for peculiar handling; it calls also for peculiar feeding. The dairy temperament calls for food which is essentially nerve-supporting in its character. You feed this Hereford cow all the corn she will eat, and she will store up carbon in her system, and,

miser-like, she will lay it away. But if you feed this Guernsey cow or this Holstein cow in that manner, you will very soon impair the action of the nervous system, and then you have destroyed the maternal function. You can take a very finely bred Jersey heifer when she is a year old, and proceed to feed her corn meal, and absolutely spoil her, destroy all the maternal machinery and nervous action of that animal. I took three Jersey heifers bred by me from one cow. The first one was a beautiful heifer, and made a famous cow. The second I laid out one side for the purpose of seeing if I could spoil her in this way, and I fed her in this manner and made her absolutely useless. The third one became a very fine cow, like her older sister. The old cow gave me three heifers in succession. The middle heifer I fed with corn meal, and destroyed the entire action of the nervous machinery. Now, if you are feeding a cow for maternity, you must give her nerve-supporting food, because the action of this function is based upon the nervous machinery. You 'must handle her conducive to her work; you must feed her conducive to her work; you must breed her conducive to her work.

But there is another side to this question, gentlemen, and I am done. A dairy cow based upon the nervous temperament, fed upon the nervous temperament, handled upon the nervous temperament, is susceptible to nervous diseases. Now, remember that she becomes more susceptible as you more largely develop her nervous machinery, and she is particularly susceptible to milk-fever, and this, as I have shown you, follows nervous channels. Some men claim that milk-fever is a disease of the blood, some men claim it is a disease this way and that way; but I know that it follows these nervous channels that I have spoken to you about, and I believe it to be essentially a nervous disease, a disease of the nervous system, and lying right in this sympathetic plexus and following it to the spine. Now, as you enhance the power of the nervous system of a dairy cow, you are subjecting her to enlarged dangers, and you need to consider this always in relation thereto. I thank you for your very kind attention.

Dr. Loring. I desire to offer a vote of thanks to the gov-

ernor for his admirable lecture, and to add a few practical words to what he has said which possibly may be of service to those who are interested in dairy cattle.

His analysis of the structure of the cow has been most admirable, and what he has said in regard to her nervous organization has also been most admirable. Now, in order to simplify the whole thing, let me give you a rule for judging of a good cow exactly in accordance with the theory which he has given us. In the first place, the head must be clean and well-shaped, as he has said; she must have a long, fine neck; and the spine should show a rough and uneven surface as you pass your hand over it. The spinous processes should be prominent. The shoulder should be very open at the base, — I mean above the fore leg, — and should have at the joint a little cup-shaped cavity into which you can insert your finger. That will tell a great deal in regard to the capacity of a dairy cow. The ribs, as the governor has described, should be wide, flat, and delicately constructed, and widely separated. Then with regard to her foot, a long hind foot and a wide fore foot is the foot of a good dairy cow. An upright, straight, stumpy hind foot always indicates a capacity for taking on fat. The hide of a dairy cow should be elastic and thin; and, as a well-developed nervous system always indicates a milk-producing faculty, her milk-vein should be large and prominent. So much for the structure, which, if followed, will always secure to you a good dairy cow.

Now, one word about milk-fever. What the governor has said in regard to it is entirely in accordance with my own observation and my own experience, and the remedy is the simplest in the world. I have had many cows ill with milk-fever, and have lost some of the most valuable of my imported cows. I learned after a while that if I wrapped a cow that was ill with this disease in thick, heavy blankets, soaked in hot water, she would instantly come into repose, she would cease that gritting of the teeth which always indicates the approach of milk-fever, and would almost invariably get well. That is a thing worth knowing, because, if you have a cow sick with milk-fever and send for a doctor, he doses her with something, you don't know what;

but, if you have any old horse blanket or anything that will absorb hot water, wrap her up in it from her head to her tail, and my word for it she will get well, if you take it in season.

I am sure you have all been perfectly delighted with the exceedingly interesting and admirable lecture which Governor Hoard has given us upon the dairy cow, and therefore I move a vote of thanks.

The motion was seconded and carried unanimously.

Mr. WARE. I would like to ask the governor if he can explain the relation between the nervous condition of a cow in milk-fever, and another cure, which is a pint of rum. One dose is usually sufficient, but a second one is sure to cure. Now, this is a nervous condition, and rum taken by individuals puts them in a nervous condition. I would like to know whether there is any relation between the two, according to the homœopathic theory of medicine that "like cures like." Rum will produce a nervous condition perhaps different from the nervous condition of a cow in milk-fever, and the remedy I have suggested is a sure cure. Bear it in mind, gentlemen. If you have a cow taken with milk-fever, give her a pint of rum, or whiskey will do; you may repeat the dose in four hours, and you will save your cow. Is there any relation between the nervous condition and the remedy or cure?

Governor HOARD. The only difficulty I see in that is, that up in our country the man would get it, and the cow would go without. But, speaking soberly, I do not know that I ever heard of that remedy. I never had but one case of milk-fever, which occurred in a very valuable Guernsey cow last spring. I should never have had that if I had been attending to my own business, instead of that of the people of Wisconsin. I have always been enabled to prevent it when I have had a chance to look after my own cattle. So far as the symptoms of the rum are concerned, I am reminded of a story. We had in our State a very wicked fellow by the name of Luke Taylor, and he used to get into that same milk-fever condition which you speak of. He met a fellow, a stranger to him, one day on the steamboat going up to St. Paul, and they both got in that same feverish condition.

Finally the stranger slapped him on the back, and says, "I will bet ten dollars you are a Democrat." Luke says, "My friend, don't you bet; you will lose your money. I have got all the symptoms, but I have not got the disease." That is the only relation between the remedy and the symptoms that I have ever heard of.

Mr. STOCKWELL. After the words of introduction by His Excellency, which have been re enforced by the words of the lecturer of the evening, I make no apology for introducing the following resolution for the approval of the Board, if so it sees fit: —

*Resolved*, That the Board of Agriculture in session assembled hereby petition the Legislature to enact an efficient law for the protection and advancement of the dairy interests, and to punish fraudulent sales of oleomargarine colored in imitation of genuine butter, and requests its secretary to act for the Board in promoting such legislation.

The question was put on the adoption of the resolution, and it was unanimously carried.

On motion of Dr. Loring, the Board adjourned to Wednesday morning, at ten o'clock.

# SECOND DAY.

The morning session of the second day of the winter meeting of the State Board of Agriculture opened at ten o'clock on December 3, Mr. HARTSHORN in the chair.

The CHAIRMAN. I have the pleasure of introducing to you Dr. G. M. TWITCHELL of Fairfield, Me., who will speak to you on "Some Conditions for Success in New England Agriculture."

## SOME CONDITIONS FOR SUCCESS IN NEW ENGLAND AGRICULTURE.

BY DR. G. M. TWITCHELL, FAIRFIELD, ME.

I have selected the above as a suggestive topic, around which I may, if possible, gather a few thoughts of interest to the practical farmers present. Agriculture, in New England to-day, is in a peculiar condition It is passing through a crucial period. The past decade has witnessed wonderful progress in the arts and sciences, and these, with the inventive genius of the age, have been poured out to cheapen in every way the cost of living.

As all food and raiment come from the soil, and the products thereof, it follows naturally that, with every step tending to decrease the cost of the manufactured article, additional burdens are placed upon the producer of the raw material. This is inevitable, and hence, in considering this question, cannot be ignored.

To secure all that is possible, a great network of iron bands has been stretching out in every direction, all over this continent. The voice of man has been passing under the great waters, and heard in the remotest corners of the globe. Commerce, with its white sails and giant wheels, has been cutting broad channels in the mighty deep, and all the forces of earth, air and sea have been combining to bless

the world, add to its wealth, and bring comforts to the door of the humblest laborer. That there is a Providence in all this, no one doubts. The toilers of the old world look to America, as the child does upon the fairy lands of the imagination. Through the massing of all the agents of nature, under the guidance of the wonderful brain of man, the products of the earth are brought within the reach of the humblest. At the same time the lines, formerly so marked, which indicate the difference between profit and loss, have been drawing together. The conditions already noticed have been instrumental in this, so that to-day the cry going up from the farm-homes of New England is, "What and where are the conditions for success?"

The great West, with its vastness of land and products, is knocking at our doors, and coming in direct competition with our farms. The extremes of the earth wait only a slight fluctuation to pour in their surplus by and through the doors which commerce is opening. Thus blessings on the one hand seem to be curses on the other, and to-day we are forced to turn from our labors, and seek avenues of relief. How can these be found?

In the business world about us the same condition prevails. These railroads, telegraph lines, cables and vessels have been massing the products of the globe, and competition has been hemming men in, on every hand, until to-day, those who have failed to watch the drift of trade, to keep pace with the times, to observe the conditions and appreciate the situation, are crying, "Show *us* the way to success." The laws underlying business remain the same, but the conditions have changed.

Competition, which is the life of trade, has been crushing with its giant power those who failed to keep pace in the race, and wrecks are to be seen all along the highway. Wealth is being rapidly added to the country, but the bulk is being concentrated into the hands of those whose fingers are on the public pulse, and who trim their sails to catch every change in the winds of trade. To-day, in the great centres, the margins are so narrow that, had they prevailed ten years ago under conditions then controlling, no man could have withstood the storm. In the quiet of our rural homes,

watching the drift in agricultural circles, we do not realize what competition means in the great marts of trade; and, failing here, do not apply the lessons as we should. I say, again, the man who enters business to-day, observing closely the conditions and standards of ten years ago, invites ruin, and will be sure of a permanent guest. Profits have been dropping, dropping, dropping, by reason of competition, until now they are found in the mills, not cents, and in the discounts for cash.

Right here may be found one of the conditions for success. If, as I have attempted to show, the margins on farm products have been dropping because of competition, the first lesson seems naturally to be to combine in competing for what may be secured. Right or wrong, and the justice or injustice of the question, we will not pause to discuss; competition must meet competition, combinations must be made against combinations, organizations must be pitted against organizations; and here is the first condition for success to which I would urge attention. In the few minutes allotted me, I can only hint at thoughts I would be pleased to elaborate. All through the business world men are turning to organization as a means of relief. Boards of trade, trusts, brotherhoods, trade unions, — all these but represent the same idea, that through co-operation — a mutual coming together — better results may be secured.

I am not here to-day to speak especially for organization, though it must be reckoned one of the first conditions for success; but I should be false to every consideration, false to my obligations to my brother farmers, false to my manhood, if I failed to call attention to the grand work which the order of Patrons of Husbandry is doing in my own State, and the assistance it has been to farmers in helping solve this great problem. My life for the past few years has largely been spent on the farms, and in the farm-homes of Maine; and wherever the grange has established its home, and lifted its halls, as it has all over the State, it has not only offered the opportunity, but, by the faithful labors of the patrons, it is securing substantial results. You may have your farmers' clubs or other organizations; but I tell you farmers of New England that to-day more can be

gained in the search for success in agriculture, through the door of the earnest, working grange, backed as it is by the boards of agriculture, than by any other organization in existence. The great problem is still before us, calling for united study and investigation, and only by uniting our efforts can the question be solved.

The day for increased prices has gone. If the great beef industry has touched bottom, as many believe it has, the profits of the future are to be found not in a higher range of prices so much as in a more active demand. This admitted, the first great question to be solved is that of cost of production. Here the individual will fail. There must be a coming together, a union of effort in study and investigation. He must be in constant touch with those engaged in the same line of work, and this calls for organization. Had this been the practice of the past, the cry to-day would not be, show us the way to success.

There must be more faith in ourselves, our calling and our farms. I do not stand here as a farmer fresh from the fields, but as one who, out of years of experience in certain lines of work, years of study and observation, and an acquaintance with farmers who, having faith, have secured results, has satisfied himself that farming in New England is being and can be made profitable, and to-day, in spite of difficulties, this faith is unshaken. Here are the farms ready to respond to the call of the intelligent laborer. Here at our doors are the best markets of the world. Here are blessings, born of necessity, nurtured in poverty, and firmly planted in our New England institutions. Here are social privileges unequaled anywhere. Here is a standard of education which calls forth admiration from every quarter of the earth. If more of earnest toil is required, greater blessings wait the struggle. If climate and soil, on this rock-bound coast, demand sturdier blows, they insure a more rugged type of manhood; and the men and women grown on our hills and under the shadow of our great mountains go out to all quarters of the globe, and there lead the thought of the inhabitants wherever they may pitch their tents. The West or South cannot offer like attractions, they cannot insure the full measure of compensation.

The same self-denial and toil will give better results in Maine or Massachusetts than can be possible on the ranches of the West. I would not have our children live as their grandfathers did. I rejoice that our farm-houses are so rich in comforts and adornments; but I would that we had a better appreciation of these, because here are some of the conditions for success. It is not the amount of crops or stock grown, but the profit which *may* be realized, that should determine location.

I said I believed in New England. Had we sung its praises and made prominent its possibilities, had our homes been full of love and faith, we should not to-day be considering the conditions for success.

One of the conditions lies within us. It is that we *look* for success, that we *believe* in success, that we in faith *work* for success. Drifting does not develop manhood. What should we say of a merchant who should commence business with his mind full of doubts?

Last winter a terrible disease prevailed in a foreign country. Our public prints were full of it in all its phases. It reached our shores, and found a people anxious to embrace it, and who would have been disappointed had it passed our doors. It was "Hinglish, you know," and therefore popular. The symptoms were so minutely described that one couldn't sneeze but those who heard said "La Grippe." I do not question the prevalence or deadly ravages of this disease; but what I do claim is this, that talking about it, preparing for it, expecting it, placed people in condition physically and mentally where they were unable to successfully cope with it. I am not here to discuss psychological facts or theories, and only give this as an illustration of my thought.

During the past ten years the public print has been full of dark pictures of agriculture; even the agricultural press has printed column upon column, questioning whether farming paid. In the homes doubts have grown into beliefs; questionings about the prospects and possibilities of the farm have filled the ears of the children. From morning until night one song has been sung, — that farm life is drudgery, that it doesn't pay, and there's no sunshine in it. To seal the lesson, State bureaus of information have advertised, far

and wide, every deserted farm, no matter what the cause or location. Is it any wonder that faith in agriculture in New England is lacking, and that results are not forthcoming? No man ever rose above his ideals, and if, as he toils, he questions, the end is just as certain as that time passes. Success does not lie in this direction, and it is your duty and mine to bend every energy, to labor faithfully, earnestly, continuously, to create faith in and a love for New England farm-homes. The hill is before us, but we must climb; and, doing this, the door opens wide leading to success.

Go with me along the business streets of the city, and the intelligent man will inform us that here one attempted trade, and, having no knowledge of details, failed; there one embarked, and, because of poor debts, went under; again, one started on a penny-wise plan, and met defeat. Have these things been advertised? Has the press constantly called attention to the business failures? Turn for a moment to manufactures, and deserted shops and privileges may be seen in every direction. Why not gather up these statistics, and publish broadcast? Why not bring into prominence the failures here? Simply and only because doing so would injure the material prosperity of the people. Will not the same effect be produced here? Why do we, lovers of and believers in the farms of New England, allow these burdens to be shifted upon the farmers? The facts are, men succeed in trade when, seeking suitable locations, they stamp their individuality upon their business by attending strictly to details. Failures in manufacturing are due to poor locations, changed conditions, or for want of business methods, properly applied. Deserted farms are to be found, but they were located when times were different, and their present owners in many cases showed greatest wisdom when they gathered their flocks and came down from the high, rocky hills and light soils, and located in fertile meadows or near good markets. One of the conditions for success, then, is to be found in ceasing to do evil and learning to do good, ceasing to advertise deserted farms, and advertising the successful farm operations which lie all about us. We must put a stop to negative preaching and teaching, whether in public print

or on the farms. Positive work is wanted, for this will insure positive results. Plant in the mind of the young man the thought that upon the farms of Massachusetts he can win success, while all the time being lifted into a higher and truer manhood, and he will go out and demonstrate the truth of your teachings. Plant but a single doubt, and you have destroyed all hope.

A condition for success not appreciated as it should be, is that of checking the outgo of so much money from the farms, for farm products. To what extent we, as a people, are paying out for what might be produced at less expense at home, no one can imagine. Here is the work of the future, to multiply the farm products adapted to the farms of Massachusetts. If you are protecting, saving and utilizing all the wastes about the place, liquids and solids, you are not only adding to the fertility of your farm, but you are in best condition to use understandingly, and with greatest profit, commercial fertilizers. If any portion of the natural means of fertilization is lost, your farm is in danger of slipping from under you. The commercial article has its mission, and it is to supplement, but not to take the place of. At our desks we make complete formulas for growing all crops, but the land cries for the natural food, the farms fail for want of barn-yard manure.

In Maine, from $600,000 to $700,000 were paid out in 1889 for commercial fertilizers; in New Hampshire, $650,000; and in Massachusetts, nearly, if not quite, $1,000,000. If all had been saved about the buildings, and properly utilized, would this investment have been necessary? Should not a measure of this drain be checked by better methods?

What per cent of the corn consumed in Massachusetts is grown here? In Maine one firm in 1888 sold almost 9,000,000 bushels. In this State the amount purchased by the members of the Boston Chamber of Commerce aggregated 12,000,000 bushels, and a large per cent of this was distributed over the State, and fed by the farmers. If corn can be grown in New England for forty cents, is it good business practice to pay sixty or more, unless one is bending all his energies, and producing to the utmost a still

more profitable crop? Success in agriculture does not admit of slip-shod, indifferent methods. It has become fashionable to complain and question, and at the same time do virtually nothing, because the fire is scattered over the whole range of products, and details are neglected.

As in the mercantile world success lies in doing a larger business and thus overcoming the loss otherwise sustained by reason of a lower range of profits, so in agriculture it must be found in more intensive culture, the introduction of labor-saving machines, and the complete cultivation of larger areas, thus reducing cost of production. The lower range of prices sure to prevail in coming years can thus be successfully met, and profit realized. By conducting farm operations to-day upon strictly business principles, a fair measure of success may be secured.

Away up in the north-east of Maine may be seen the most wonderful section of country to be found in all the eastern or middle States. Those Aroostook fields, lying in gentle swells, are rich and fertile, but they are removed from the great centres, and transportation is a heavy item; yet the farmers there are finding prosperity, for they have solved this question, and, by putting business into their farm work, are happy, contented, and growing wealthy.

Is there a stock feeder finding the balance on the right side of the ledger at the close of the year? then every other feeder might find the same by the application of the same degree of skill and intelligence. If these are not introduced, shall we charge failure to the industry, or the man? Why have you not a hundred Deerfoot farms in this State? Is it not because you have not the men willing to give the energy and application which have insured success there?

Gentlemen, the opportunities for success lie all about us. Precious gems are at our feet; but, in the mad rush for wealth, in the vain endeavor to grasp the whole, we stumble over the little things out of which enduring results are to be builded.

The dairymen of Maine, who have, by a careful study of individuals, by breeding and weeding, by weighing and selecting, secured a herd every one of which will yield three hundred pounds of butter yearly, have success within

their grasp, provided they have at the same time, by and through a study of the laws of feeding, by weighing and measuring, and balancing rations to individuals, reduced the cost of prodution to fourteen cents a pound. The profitable dairy cow to-day is the one producing the pound of butter at least cost; and this must be our standard of measurement. The dairy is our sheet-anchor in New England, and, as a people, we have not entered into an appreciation of its value. If you can sell your hay and grain at market prices, in your barns, and your pasturage for what it is worth, and retain the food elements for maintaining your farms, — yes, for increasing their fertility, — you have as good a business as a man need ask for. The dairy offers this, and more, but its demands are exacting. There must somewhere be a perfect ration for each individual, and the conditions for success require a patient searching for this, through series of experiments. Our animals are but tools in our hands, to be changed, molded, reconstructed, as we may desire. The milkmen whose cows yield annually six thousand pounds of milk per head, are not vexed about this problem, provided that, by the same study of rations, by the same care and skill in breeding and feeding, by selecting food with sole reference to results, and with no thought of first cost, they *know* that each cow is yielding a profit. It is the want of this knowledge which has emptied so many barns, and chilled so many hearth-stones. Knowledge is power, and to *know* that any line of operations is successful, gives not only confidence, but assurance and courage. Here, to my mind, is the great want of to-day. How few can stand and say, "*I know*" the cost of production in the classes in which I am interested. Give us this knowledge as the result of combined work in our organizations, and agriculture will at once step to its proper position. For want of the application of business principles, the keeping of accounts and *knowing* where profit is sure to be found, we are here to discuss together these important questions.

The cranberry grower of the Cape, who intelligently prepares his bog, sets and cares for his crop, and observes the conditions which govern, does not need to discuss the question before us. Here is an industry worth nearly three-

quarters of a million dollars yearly to Massachusetts, capable of being greatly increased; and yet men stand asking to be shown the way to success in agriculture. The market gardeners about Boston or Worcester, who have studied this problem of intensive culture so closely, and are reaping a profit from every rod of land, have settled the question. Find success? Why, that's what they are after, and they know no such word as fail. In 1885, in Massachusetts, the growers of onions, cabbages, celery, squashes, strawberries, tomatoes and tobacco, realized two and a quarter millions of dollars for their crops, and with each there has for the past five years been an increasing demand and a fair profit, because, while prices have not advanced, growers have by improved methods, special fertilizers and more complete knowledge, reduced the cost of growing, and so found success.

On the hill-side farms of Maine the orchards yearly bear rich harvests for those who intelligently plant, cultivate, prune and foster; and those whose ears are open to the calls of the market are multiplying their trees as fast as consistent with good culture. To my mind there is no future for the farmer who does a little of most everything, and not much of anything. The whole drift of the times is away from these practices, and the call ringing all along the line, and coming with tremendous power to those who watch the drift of thought, is for concentration upon those lines for which the individual is best adapted.

In the olden time the voice of God came unto Moses, saying, "Speak unto the children of Israel, that they go *forward*." So to-day the same cry rings out from every quarter. The silent forces of nature catch the refrain, and bud, leaf and fruit tell of the rush toward perfection. *Go forward* is the command which, as we toil in field or barn, we should hear, and, hearing, obey. The perfect standard is yet before us in fruit, seed, crop, animal, and also in man. The certainty that the highest results have not yet been obtained should lead to fresh endeavor and renewed zeal.

When we stop and consider what marvelous strides have been made in every direction during the past quarter of a century, hope should be strengthened for the future. Viewed by the standards of that period, the dairy cow of to-day is a

monstrosity; yet we have the fact continually before us that our herds are not yet up to a normal standard of production. I have not attempted a discussion of the conditions for success in growing horses, sheep, swine or poultry. The same general principles are involved, and everywhere the cry is for individual merit, backed by blood inheritance. There always was and always will be an active call for the well-bred horse, provided that from birth to maturity it has been fed and educated with the one thought of highest excellence. There is no room for scrubs in the market of to-day, whether of animals or men. It will not do to rest on blood or breeding, because the call is for the individual; and as the lines converge, as they surely will, and the demands grow more exacting, the standard must continually be raised. Early maturity in everything must be our watchword, if success is to be grasped. The profits of poultry culture can hardly be imagined, after all the years of breeding and study of rations. Success to-day is to be found in turning the currents into the channels most desired at maturity, and thus early fixing the tendencies. I believe that the value of the matured animal, in any special line of production, is fixed during the first year, and that, from the first, systematic work should prevail. Selections of sires and dams must be with the one thought of increasing the product or making more rapid growth. The feed from birth should be selected with sole reference to this, and by regular habits the animal best fitted for its peculiar vocation.

We speak of nature's methods; why, every condition is unnatural. The horse was created to bound over the hills and plains at will, not to run a mile in 1.37½, or trot in 2.08¾. The dairy cow by nature would give milk sufficient to rear her offspring, while we are seeking for ten thousand pounds of milk or five hundred pounds of butter yearly. Nature never created the eight-foot ox, or the magnificent Percheron. Man must have the credit for these grand results. The hen in her wild state hatches perhaps two broods in a season; we want two hundred eggs or more yearly, and, wanting these, we reach after and secure them. Size, color, form, growth and production, are all unnatural conditions, and only indicate how much man has accom-

plished, and the possibilities of the future to the intelligent grower and feeder.

As our standards diverge from what is natural, there comes the demand for a corresponding degree of skill and intelligence. Unless we keep ourselves constantly in touch with the forces and agents operating about us, there can be no success. Hence we must turn to education as an important factor in determining results. Thus far I have attempted to indicate lines of work possible to the individual. If living near a market, its highest demands must be met. If more remote, then the call is for the conversion of the raw product into what will represent the most in value, and remove the least from the farm. Here are the conditions for success, and, when these are solved, New England, with her soil and climate, her railroads and rapidly growing markets, can compete with the world in the farm products adapted to our climatic conditions.

While borrowing trouble, we have overlooked one important factor; that is, that distance cannot be annihilated, and that your farm is from twenty-four to sixty hours nearer the great distributing centres than are the prairies of the West. Count this a blessing of no slight value, and take fullest advantage of it.

Agricultural education *must* be made to point the way to the best means, measures and methods in agriculture. Does it do this? I think not, because the scientific work there attempted is above and beyond the grasp of the average farmer. I do not intend this as a criticism, not in the least, but as a condition to be changed. Teachers and instructors are obliged to maintain a standard consistent with the spirit of the original act of Congress, and in harmony with the advanced thought of to-day. At the same time *we* recognize the fact that, unless they guard closely every step, and force themselves out of the atmosphere of the library and laboratory into that of the farm and actual farm life and thought, they will drift away beyond the reach of the practical, every-day farmer. Where is the relief? It is to be found in our common schools. Here I approach what, to my thought, is the chief condition for success, and to-day is the prime cause of failure. Take the text books in the

majority of schools, from the primer to the higher English, and they are tinged with metropolitan thoughts and sympathies. If any attempt is made to picture farm life and rural scenes, they are wholly superficial and indirectly misleading. More than this, very many of the writers of our text books have not the slightest sympathy for the farm, or appreciation of agriculture; and thus the atmosphere of the school-room draws away from the farm. Here is work for us who believe in dignifying farm life. Agriculture must be popularized, and the first step is to secure the introduction of text-books having to do with natural things. The child must be led to see the beauties, and, while in a receptive state, drink in a knowledge, not directly of agriculture, but of the countless beings and things it sees and handles daily. Doing this, the mind will be disciplined, while leading the child up to a comprehension of some of the wonderful mysteries of nature, — mysteries which crowd in upon the farmer on every hand, massing about him for his glory and relief. He cannot touch an object of his care but a miracle is manifest; he cannot plant a seed but a miracle is wrought; and, because we have ploughed, planted, and harvested, grown our stock and products without reaching after these mysteries, and seeking to come into a knowledge of their significance, we find agriculture wanting one of its grandest compensations.

My thought is this, that it is both possible and practicable to lead the child, at school, to a love for and interest in the natural things we meet in farm life, and at the same time train and educate for practical business life; and that, doing this, we shall find that farm life will have added attractions, the boys will go out of our common schools with appetites whetted by a familiarity with natural things, and enter our agricultural colleges to learn more of the mysteries of the soil and of plant growth. Then will the corps of earnest workers find classes multiplying, and graduates will go out upon the farms, and the wilderness will blossom as the rose and the waste places be made glad. Seventy-five per cent of the scholars drop out of the common school into active life. How necessary that the early training be such as will be most helpful, and that our schools for special instruction reach down a helping hand, and lead these boys

to an appreciation of the possibilities of farm life. Show a boy that here is room for the display of all his talents, here is opportunity for him to exercise all his powers, here are sure returns, and here he can give full scope to all his fancies; and, while with one hand he toils to secure substantial results, with the other he may be reaching after and grasping the mysteries of God; and agriculture will call to its assistance the energies of youth, and, having these, the door will open wide leading to success, and blessings will come to New England.

Another condition to which I must call attention is to be found in a better appreciation of the duties and responsibilities of citizenship. With what party you act it is nobody's business. Your duty is to affiliate with that one which most fully represents your convictions. Having placed yourself in line, it is then your duty to act, and act for your own best interests. No class should be so intensely political as the farmers. Upon your shoulders falls a measure of responsibility if burdens are heavy, if unjust legislation has prevailed, if wickedness is to be found in high places.

In the ways indicated, I believe that agriculture can be made popular; that the sting of reproach, invited by so many slip-shod practices in the past, may be removed; that, by and through the application of business principles, such as prevail with successful firms, substantial results may be gained; and that, by and through a study of natural things in early childhood, it is possible to plant deep and firm a love for the farm, which, in after years, will be manifest in a better system and increased wealth.

I do not stand here to paint a rosy picture for the farm, — I do not and would not mislead, — but because I believe there is a future for New England; that these hills and valleys may again be covered with flocks; that these fields may again sing under the weight of increasing harvests; that the herds may be multiplied and made sources of wealth; because, when we stop and measure compensations, we shall find that here are the opportunities, here the possibilities, and *here* we may find profit in agriculture.

This is not a fancy of the imagination, but may be made

real to you farmers of Massachusetts, if, *having faith, it is manifest in works.* We are in a measure responsible for present conditions, for the fogs of doubt and distrust hanging so heavily over the farms. These blind the sun of promise and blight the seeds of faith. It is your duty and mine to arouse ourselves to action, — specific, positive action, and thus scatter these fogs, and let in the sunlight to warm the earth and drive away the malaria of doubt. We are responsible, as individuals, for poor conditions, poor methods, poor practices; and we must change our courses, and give more time to intelligent farm work and less to magnifying the ills of life. Doing this, we shall find that the currents now turned outward will be centered within; that substantial blessings are being secured; and that, by reaching after higher and better results, in the faith of a brighter future, we shall be lifted to a truer and nobler standard. Only in this reaching and seeking and striving, only in this toiling and fighting and growing, can the conditions for success be found.

"Labor is rest, — from the sorrows that greet us;
Rest from all petty vexations that meet us;
Rest from sin-promptings that ever entreat us;
Rest from world-sirens that hire us to ill.
Work, — and pure slumbers shall wait on thy pillow;
Work, — thou shalt ride over Care's coming billow;
Lie not down wearied 'neath Woe's weeping willow!
Work with a stout heart and resolute will!"

The CHAIRMAN. You have heard a voice from Maine in regard to the agriculture of New England. We have an hour or more for the discussion of this subject, and it is your privilege to question the doctor upon any point with reference to which you may desire information.

Mr. AUGUSTUS PRATT of North Middleborough. I should like to ask one question in regard to the great leakage of the fertilizing elements of the farm. I understood the lecturer to say that there was a waste of seventy-five per cent. I would like to know if we are guilty to that extent in our own State.

Dr. TWITCHELL. I do not know whether it will apply here, or not; I know it applies in the State of Maine,

among some of the farmers in the sections where I am best acquainted. No doubt there are some who save and utilize the liquid manure, which contains sixty-five per cent of the manurial value of the whole; but you see that if this is not saved, and the solids are thrust out of doors, exposed to the sun and rain, you have only to lose ten per cent by leaching and evaporation in order to make up the seventy-five per cent. This is a matter which farmers very generally neglect; and where farmers in the State of Maine are saving and utilizing their liquid manure, they are not obliged to use such large amounts of commercial fertilizers in the growing of special crops. This waste must be checked before we can find profit in agriculture.

Prof. ROBERTS. Did you ever know a man to get poor cutting lodged grain?

Dr. TWITCHELL. No, I don't know that I ever did. A farm that will yield lodged grain is a pretty good farm to have.

Mr. HICKOX. My experience teaches me that we cannot raise potatoes in Massachusetts as they are raised in Aroostook County; we must raise something which will return to the soil the fertilizing elements, and to do that we must use fodder and stock.

Dr. TWITCHELL. I do not think any gentleman here felt for a moment that I was advising you to follow Aroostook County in your business. I intended to make prominent this thought, — that every man must be a law unto himself, with his own farm, his own conditions; and that he must use his intelligence, study his farm, and learn what that farm is best adapted for. I believe that a man should know his land, what his land will respond to most readily; and then, by applying that knowledge in the management of his farm, he will secure success.

This leads me to give expression to another thought, and that is, that a man must always do something for which he has a liking. I believe there is much in that. Take any young man who has a liking for a trotting horse, who wants all the time to be in a sulky, and give him the best Jersey cows to be found, and in five years he will have them in the harness. You cannot transform an individual as easily as

you can an animal. I would have our young men get into those lines of work for which they are specially adapted, and then they will find success.

I have a letter here, and you will pardon me if I read it. It is of interest to me because I have had something to do with the matter. I found a young man in Maine engaged in a general line of farm work, raising general crops. He asked me if I thought he could succeed in small fruits. I found, upon questioning him, that he had been studying the small-fruit question, and was interested in it. I advised him to get into that business a couple of years ago, and, if you will pardon me, I would like to read a portion of his letter, simply to show you what he has done. He had a very good orchard, and by fencing he had turned his hogs upon it, and enriched it materially. He writes me as follows: —

"I suppose you would like to know how my fruits have yielded this season. I can say if it had not been for my fruit I should be about bankrupt, for my grain and beans were almost a failure. My potatoes were fine, but I only raised about forty bushels, so that is a very small item, although desirable. My strawberry crop was in round numbers one hundred and twenty-five bushel crates, and brought me five hundred dollars. Not a very great showing, but fairly good results. The grubs got about one-quarter of my setting of 1889, so I did not expect so large a crop on that account. For blackberries I received one hundred dollars. The dry weather at fruiting time pinched the crop quite badly. To the present time I have received about four hundred and twenty dollars for apples, with two hundred and fifty dollars' worth in the cellar. So you see I have had the pleasure of growing and handling the fruit, which to me is a great attraction, and for the visible attraction ten hundred and twenty dollars. Not a mean item for a hard year, is it?"

Now, there is a young man who is going to make a success. He is twelve miles from market, and upon a light soil, but he is just as surely going to make a success there as that he lives, because he is engaged in a work now that he loves. He does not like a horse. He is keeping one

cow because he is obliged to do so in order to supply milk and make butter for the family; but he told me he wished he could buy his milk and butter, and not have to bother with that cow. He does not like a cow, but he does like small fruits; and he is recognized to-day as prominent among the men who are growing small fruits, especially strawberries, simply because he has got something he loves.

I found another man in Washington County this fall who was about discouraged. He had been teaching school and working on a farm part of the time, and he had about made up his mind that he should pack up and go away. Riding with me for ten or twelve days, while we were doing some grange work, we fell into a discussion of the dairy question, as I never fail to do when I get an opportunity. He became somewhat interested, and, as we drove over the county, whenever we saw a herd of cows we got out and examined them until we found one or two that suited us, and he purchased one of them and afterwards purchased another. I had a letter from him a week or two ago, giving his results. I only speak of it to show that here is a young man who has got into a line of work which he likes. He is at work upon the food problem, and he gives me in his letter the results of his tests of five cows. I refer to this because I think there is something practical here which may be suggestive to the young men present. One cow gave him one hundred and one and one-half pounds of milk in a week. She made seven and one-half pounds of butter; that is, a pound of butter for every thirteen and one-half pounds of milk. The cost was sixteen cents per pound. Another gave him one hundred and twelve and one-half pounds of milk. She made six and three-fourths pounds of butter; that is, a pound of butter for every sixteen and two-thirds pounds of milk. The butter cost seventeen and one-half cents per pound. Another cow gave him eighty-three and one-half pounds of milk, which made six and one-eighth pounds of butter. That milk required thirteen and three-fourths pounds to make a pound of butter. The butter cost nineteen and one-half cents per pound. Another cow gave him one hundred and one-half pounds of milk, making six and six-sixteenths pounds

of butter, requiring fifteen and three-fourths pounds of milk for a pound of butter. The cost of the butter was eighteen and six-tenths cents per pound.

The ration he is feeding his cows is sixteen pounds of hay, two pounds of corn meal, two pounds of cotton-seed meal, and two pounds of shorts. He estimates the hay at ten dollars a ton, and his corn meal, cotton-seed meal and shorts at one and a half cents a pound. He is away down in the extreme eastern portion of the State of Maine, and to-day his rations cost him seventeen cents a head, and here are the results of his testing of his cows to see what they can do. He says that he proposes to work upon that problem this winter, and see whether there is anything in it, or not. I believe he will find that there is enough in it to encourage him to go on and work out his salvation, as he will.

Mr. F. J. Kinney. You have not said anything about ensilage. Do you recommend farmers to feed ensilage?

Dr. Twitchell. Do you feed ensilage?

Mr. Kinney. I am not a practical farmer, but I do believe in ensilage.

Dr. Twitchell. I asked a lawyer once if he could tell me in a sentence how he found success. He said, "Yes; I always try to find what the advice is my client wants, and then bring the law to suit the case." The farmers of the State of Maine are not feeding ensilage as much as they do in Massachusetts. In certain sections they are feeding it, and finding it profitable. I know of some few instances where they have given it up. But I must say that I believe ensilage is to become one of the sure foods of the future.

Mr. Dyer. Allow me to ask the price of hay in Maine.

Dr. Twitchell. This hay was reckoned at ten dollars a ton. In making our rations, we figure our hay at ten dollars a ton. To-day it is ten dollars or less in the State of Maine.

Mr. Dyer. That will help to explain why ensilage is not used as much in Maine as it is in Massachusetts.

Governor Hoard. I want to inquire still further concerning the experience of those men in Maine who are giving up the feeding of ensilage. I want to ask how long they have been engaged in it, and the general character of the ensilage that they have been using. What is the reason they are giving it up?

Dr. Twitchell. I wish the governor would ask me an easier question, because I am unable to give an answer that I think will be satisfactory. I do know this, however, — that, where men of intelligence have made ensilage a part of a fixed ration, they have found it valuable; but the trouble with too many of the farmers is that they have an idea that the more a creature will eat the more she ought to do; and so they feed (some of them, not all) five, six and eight times a day. They put ensilage in on top of all that the creature can take care of, and then wonder why it hurts her.

Mr. Edson. Is not the cheapness of hay in Maine one cause of giving up ensilage? Our hay being worth about twenty dollars a ton, ensilage is very profitable; but, if we could get hay for ten dollars a ton, perhaps it would not be so profitable.

Dr. Twitchell. Of course it would not be so profitable; but my theory is that ensilage is profitable for a man to feed, even though his hay is worth only ten dollars a ton. It is a profitable crop to grow to make up the ration which shall preserve the health of the animal (you know how clearly that was brought out last night by the speaker, Governor Hoard); and, unless we are looking always for the best health and condition of the animal, we cannot get the best results. So I say I believe ensilage comes in as a valuable fodder, because it enables us to make a ration according to the needs of the creature. I give that as theory, not practice, but I believe I could demonstrate it in practice.

Mr. Stone of Westborough. Is not one reason why the feeding of ensilage has been given up because it affects the quality of the butter? I suppose they make butter chiefly in Maine.

Dr. Twitchell. I have never heard that urged against it, unless it has been fed in enormous quantities.

Governor Hoard. I want to add a word here. I do not think that the economy of ensilage has anything to do with the price of hay. In Wisconsin, where I live, the finest timothy hay and clover can be bought the present year for from six to eight dollars a ton. In one town adjoining my own there are now sixty silos owned by sixty large dairymen, with herds of cows ranging from sixty to eighty apiece.

The silo is used for the purpose of enabling each man on the same number of acres of land to nearly double the amount of his working force in cows. So that, if he can grow upon one acre of ground fifteen tons of good ensilage, two and a half tons of which are equal in feeding value to a ton of the best timothy, he has grown, you see, timothy at the rate of six tons to the acre, which would be a very large crop.

Mr. SADD. I would like to ask the governor what kind of corn they are planting, and how thick.

Governor HOARD. I do not know as you desire to run this into a discussion of the ensilage question. I will say that in those portions of our State where we can grow what is known as the B and W corn, the southern ensilage corn, we think that is the most profitable; and our experiment station has demonstrated that it contains the largest amount of value, on the average. But, where we cannot grow that corn and bring it to the condition of a small ear on each stalk, and that ear to the condition of glazing, we prefer corn which is shorter in its season; but, if we can get an ear on the B and W corn, we think that is the best. The great difficulty with ensilage, we have found, is to convince the farmer that a large proportion of the value of his ensilage is in his handling of his corn before it goes into the silo. The silo does nothing but simply can it. It is simply canning fodder, to preserve it. The silo cannot put anything into the fodder that does not go in in the first place.

Mr. WATERS of Chicopee. Mr. Stone asked the speaker a short time ago if ensilage was not objected to by some parties on account of its flavoring the butter. About a month ago I was in a certain town in the State of Connecticut, where they have a butter factory. The factory uses whole milk, instead of gathering the cream by the cream-gathering system. One of the patrons there told me that they objected to ensilage on account of the flavor it would give the butter. They have in that town as good farmers, as a general rule, and have as good herds of cows, as any town that I have been in for a number of years; but they are on the wrong track. I claim that there is no feed that makes any better-flavored butter than ensilage, unless you

feed sweet clover hay, and you cannot better it much on that. There is no forage crop that the farmer raises that is so profitable as good ensilage, provided he has the machinery to do it with, and does it systematically.

Secretary SESSIONS. The gentlemen who has just addressed you has been on the farm of Mr. Wilkinson, "Bright-side Farm," for a number of years, and has had the charge of about a hundred cows, making several hundred pounds of butter a week for the Springfield market, and selling it at the very highest price.

Mr. J. H. HALE of Connecticut. I do not propose to say anything in regard to the ensilage question, because I think, when we have Governor Hoard here, with his experience and his knowledge of the success of Wisconsin farmers in the use of ensilage, he can tell more about it than any man in the country. I think Wisconsin is way ahead of any State in growing ensilage corn and feeding it.

I was considerably interested in the paper which the doctor gave us on the subject of New England farming. I think he touched upon quite an important point when he hinted at the fact there is too much grumbling and growling among farmers about their disadvantages, and altogether too little said about their advantages. I think that is a question that we should all consider. I have been satisfied for some years that if one-half as much had been told of the advantages of agricultural life in New England as has been told of the advantages of other sections of the United States in getting up the "booms," there would have been such a rush of emigration to New England as has never been seen in any boomed section of America. I have had the privilege within the past two or three years of visiting farmers' homes in nearly every State of this Union, and nowhere in the United States have I found so many attractive farm-homes, so many of the comforts of life, such well-dressed and intelligent people, as are to be found among farmers of New England to-day.

But, sir, the gentleman spoke in regard to a better knowledge of our business, and the adoption of better business methods. There he touches the key-note of our success. We do have better business methods than formerly, but we have

not half business method enough nor half system enough; and, if we are to hold our own and advance, as I believe we shall, it must be done through intelligent business effort, and, as the lecturer says, each man, and especially each young man, must take up that line of business that his farm and his tastes are best adapted to. Farming in New England is not mere gathering something out of the soil under the old idea of sowing or planting the seed and then just gathering the harvest, knowing nothing about where it is going. Farming in New England has settled down, if I may use the term, to the manufacture of produce. The farm being the factory, the farmer furnishes the raw material, and intelligent labor will produce from it the finished product for which we are looking. We must be looking for the finished product, and, in order to obtain it, we must know for what the machinery is fitted, and use that machinery intelligently. Then, besides studying how to produce it, we must know something about the other end of the business. The successful farmers of New England to-day, nearly all of them, know as much about the selling of their produce as they do about growing it. After the farmer has produced his crop, he must know the other end of the line; and the successful farmers of New England have that knowledge. Find me a farmer who is complaining of his farm as "played out," who says that farming is uphill business and is "going to the dogs" in New England, and I will show you a farmer, ninety-nine times out of every hundred, who knows nothing about the other end of his business.

Let me give you a little idea of what I mean. A year ago in June I was in Chicago; and when I am in a large city I make it a practice to turn out at three o'clock in the morning, and go down into the market and spend the morning there, learning what I can about the handling and sale of farm produce. I went down to the Chicago market one morning, and it happened to be just in the midst of the asparagus season. There was a great quantity of it coming into the market. Most of it came in boxes made of white pine, but they were old, they had come and gone, back and forth, time and time again. It was very nice, fine asparagus, tied up in the usual way, but it sold at that time for six

cents a pound. There was another lot came in on the same boat, in white, clean boxes, made of very thin wood, cheaper boxes than the others, and the asparagus was of the same quality, to all appearance; but it was tied up with nice pink tape, which does not cost five cents a mile. It was nicely tied up, it looked very attractive, and it sold for ten cents a pound, — almost 70 per cent more than the other asparagus sold for. I thought I would like to go up and see the man who produced that asparagus, and I went to his farm. He told me that he had made it a practice for years of taking one day every two weeks, going to Chicago and spending the day not in looking around the streets, going to the theatre and having a good time generally, but in the Chicago market. He got up about twelve o'clock in the morning and went down to the market, to see what he could learn about the shipment of all kinds of produce. He told me that some of his neighbors said he was going to Chicago pretty often and having a good time, but he was really working as hard as when he was in the field. I have seen Kalamazoo celery sold in the Western markets (and they grow very nice celery out there), tied up with blue tape a third of an inch wide, tied at the bottom and also about half-way up to the top. This blue tape on the white celery made the bunches look very attractive, and everybody wanted it. It sold for a good deal less money than my friend Rawson gets for his celery; but, when Kalamazoo celery was selling for eighteen, twenty, and twenty-five cents per dozen, done up in the ordinary style, this gentleman's celery, tied with blue tape, was bringing thirty-five cents a dozen, — an increase of forty per cent.

So I might go on with illustration after illustration of the fact that the farmers who are studying the best methods of handling their produce are the most successful farmers; and, if you follow them to their homes, you will find that they are not talking about New England farming as "played out," they are perfectly satisfied. I have recently been in the West, the southwest and on the Pacific coast, and I found that almost any one of the farmers there was willing to sell out — for a consideration, of course — and come to Massachusetts, to Connecticut or to Maine. There are thousands

and tens of thousands of farmers in those sections of the country that are not half as well off as the average New England farmer. That speaks well for New England agriculture.

Dr. TWITCHELL. One thought that just comes to my mind, suggested by the remarks of my friend from Connecticut, I must give voice to, because it will serve to clinch the point he made. Six years ago the Turner butter factory in my State commenced with three hundred cows. The average product of those three hundred cows the first year was one hundred and forty pounds. Last year the farmers, one hundred and thirteen of them, received for their cream between fifty-nine and sixty thousand dollars. Thirteen hundred cows furnished the cream. The average product of those thirteen hundred cows was two hundred and nine pounds. It was raised from one hundred and forty to two hundred and nine pounds in five years. And that is only a part of the story. The best part of it is this, that the farms within the radius reached by the cream gatherers would sell to-day for from fifteen to twenty per cent more than the farms one-half mile outside. That is the statement made to me by the president of the company and the master of the Maine State Grange. I tell you, gentlemen of Massachusetts, it pays to put business into agriculture.

Mr. FITCH. One moment in answer to the remark of the lecturer in reference to the power of organization. He asked, "What has the Milk Producers' Union done here?" I wish to put in two points. From 1882 to 1886 the records of the State of Massachusetts show that the shrinkage in the number of cows in this State was from one to four thousand per year. The reason given and thoroughly shown was that the price of butter products, especially milk, governed by the price in the Boston market, had been in the hands of speculators and middle-men until they had crowded it down to a point where farmers could not make milk profitable unless they had extraordinarily good conditions. In 1886 the aspect of things was changed, and the Milk Producers' Union demanded a higher price. They obtained two cents more per can. In 1887 they tried again, but they did not obtain two cents more; they kept the same price that they

had, however. In 1888 they tried again, and obtained two cents more on a can for the summer; and so on, until it has been acknowledged (and this is the point which I wished to bring out) by two of the contractors, who controlled more than two-thirds of the milk that goes into Boston market, that they had been compelled to pay one cent a can more to the farmers of Massachusetts through the organization known as the Milk Producers' Union. That is their own acknowledgment, in answer to an accusation from the other side. That amounts to something over four hundred thousand dollars.

Now, let us see what effect this has had on the cows. I said that from 1882 to 1886 the shrinkage in the number of cows was from one thousand to four thousand per year. From 1886 until now the increase in the number of cows has been from two thousand to forty-five hundred per year. That tells a part of the story. It may be said that this increase has been because of the establishment of creameries. It is true that there has been an increase in the number of creameries; but that increase does not begin to answer the question where the increase in the number of cows comes from, because some creameries that were prosperous or comparatively so four years ago are not any more prosperous now, and have not any more cows. Why? Because the milk goes somewhere else.

Dr. Twitchell. Are the farmers connected with the Milk Producers' Union securing all they think in justice belongs to them?

Mr. Fitch. No, sir.

Dr. Twitchell. Is not the reason because they do not stand together?

Mr. Fitch. I will answer that in a moment, I wish to state carefully the exact reason which I would give, as secretary of the Union, for any failure in the concern. In the first place, as soon as farmers began to find out that there was power in organization, that instant they began to buy more cows, and that instant the amount of milk sent to market began to increase; and, as soon as it increased so that those who handled it could not manage it all, they began to complain of an overflow of milk. They said,

"There is too much milk sent to the market." The farmers replied, "We don't believe it." But, when it came to the question of raising the price, those who bought it could say: "Here on our desks are dozens of letters from farmers, saying that they want to send their milk to the Boston market, and they will agree to take the price that we offer." I have seen a good many such letters, and I have heard the remarks of farmers who came in. When we tried to make the price two months ago, we said: "Our milk costs two and a quarter cents a can more than it did last winter, therefore we demand a price two cents higher than we had last winter." We thought that argument could not be answered. We claimed then thirty-eight cents a can, and the buyers offered thirty-six. Their answer was, "We are perfectly sure of milk enough at thirty-six cents to fill the market, and more too." "How are you sure of it?" we asked, they turned right round and showed us the letters proving it, and, more than that, we knew it before. We did not get the advance, neither did we yield to them. We put it before the Union to vote upon it, and they did not know how well they voted. They voted not to take away the milk, not to "strike," as some people would call it, and refuse to sell their milk. A good many felt that they wanted to do it, but there were three or four alternatives. A majority voted against doing it. Why? Because every farmer knew what the price was, and they knew that their neighbors were trying to get their milk into market and could not do it. Three weeks ago the heaviest contractors came to me and asked me, "Won't you come with us on the 7th of November, and fix the price of the surplus milk for October just as you have for the past two years?" Do you believe I went? Not very much. They had got themselves into a trap. It took us a year and a half to get the privilege of looking at their books so that we might be able to say to the farmers of Massachusetts and New Hampshire, "These figures are correct; this amount of surplus has been put upon the market, and these prices are honest prices." We have done that for two years nearly, and done it against the wishes and in spite of the contractors. Three weeks ago they came to me and asked me to meet with the committee

and fix the price of the surplus. What for? How did it happen that the tune was changed? Because they wanted we should come and take the curse off of the price for the surplus that they expected to put on for the October milk. I ask the judgment of the milk producers before me on this question, Has organization done anything for the Massachusetts farmers?

Voices, — "Yes, yes."

Mr. Lynde. I would like to ask the gentleman how much there is in a can.

Mr. Fitch. Eight and a half quarts.

Dr. Loring. I would like to say one word this morning upon a topic which the distinguished lecturer discussed, of a rather more general nature than that which has occupied the attention of the meeting since he closed. I think New England farmers are capable of discussing almost any question of a practical nature. I see men here who are experts in market gardening; I see men here who are experts in managing the dairy; I see men here who know all about orcharding. If I wanted to learn anything in regard to any one of these specific things, I should know perfectly well where to go in order to get the information I wanted. But I desire to say one word in defence of New England farmers. It has become extremely fashionable for men to decry farming in Massachusetts. There are certain organs that are continually dwelling upon the diminished number of farms in the New England States. We do not hear these views expressed in regard to any other State. We seldom see any account of abandoned farms in New York or in Wisconsin.

Governor Hoard. We have got them. We have got some that ought to be abandoned.

Dr. Loring. I say we do not often see any account of abandoned farms in other States, but here it is continually sounded in our ears that the farms of New England are being abandoned on account of their unprofitable character. Now, it is true that the farms of this State have been reduced about four thousand from 1870 to 1890; that is, there were forty-seven thousand farms in 1870, and now there are about forty-three thousand. The question arises whether that indicates the precise condition and activity of Massachusetts

farming. I am perfectly sure that it does not. The farms that have been abandoned lie in localities where it is utterly unprofitable to cultivate them, and, while they have produced in former days admirable crops of fruit and hay and cattle, when the Massachusetts farmer could sell his cattle in a profitable market, the time for those products have gone by, and these farms are so far away from the markets that it is utterly impossible to cultivate them to any profit. That they are entitled to respect and affection there is no question, as the birthplaces of some of the most remarkable men ever known in the Commonwealth. The great statesmen who came from the Connecticut river region to Boston to conduct the affairs of the State, like Governor Strong and his companions, were born on the farms in that section of the Commonwealth. Now, many of those farms have been abandoned because the attention of the young men has been drawn to the farms lying further West, and to the great centres of trade in New England; but, if you will take any agricultural section of Massachusetts, you will find that in that section there are more leading and powerful men raised to-day than there were fifty years ago. I do not mean to say that any one town does this, but take any section or any tier of towns, and you will find going out from those towns to New York and to the other large cities of the country more great merchants and professional men than ever before. New York, Chicago, Boston and every large city are filled with notable instances of country boys who are conducting our great enterprises. I could find in any given section as many able and controlling men to-day as there were fifty years ago, in proportion to the population.

Now, so far as the rearing of distinguished men is concerned, that is my answer. The farms that have been abandoned have been abandoned because they lie in such localities that it is no earthly use to try to carry them on; and they now lie there ready for occupation by pleasure-seekers, by persons who want beautiful localities, which they can find on those farms, and by men who want a place at a small cost. But meanwhile the farming interests of Massachusetts have increased enormously in value. Let me illustrate. The aggregate value of the farms in the Com-

monwealth has increased more than double in the last twenty years. The cultivated acres have also increased, from 881,402 in 1865, to 939,260½ in 1885. The amount of land devoted to market gardening has also increased, from 3,988⅝ acres valued at $1,024,286 in 1875, to 8,861⅞ acres valued at $3,088,826 in 1885. The value of the products of the farm has increased from $37,073,034 in 1875, to $47,756,033 in 1885. It is important to know of what this increase consists. In 1885 the crop of strawberries amounted to 3,930,710 quarts, valued at $406,895; the crop of tomatoes amounted to 322,056¾ bushels, valued at $164,307; the cabbage crop amounted to 11,499,817 heads, valued at $556,518; the amount of milk produced was 72,528,628 gallons, valued at $10,312,762, the yield having doubled in value and quantity in ten years. The hay crop in 1885 was valued at $7,289,829.

You cannot find a single branch of agriculture — except the growing of wholesale crops, in which the Western farmers are competing with us — that is not conducted profitably in the State of Massachusetts. Do you know any man who is devoting his attention to poultry, who does not make money out of it? I know that in Essex County (and, while I am very proud of Essex County, I do not undertake to say that it is the most important county in the world) — I know that in that county every man who devotes himself to the raising of poultry makes money out of it. There is no man in Essex County who devotes himself to market gardening who does not find it a profitable business. There is no man who is devoted to the production of milk for the market, as an adjunct to his other business, who does not find that profitable; and, wherever you find in front of a farm-house door on a summer morning a cluster of milk cans sunning and airing themselves, you will be pretty sure to find a thriving household and good farming. And yet I am told that farming is on the decline, and that the farms of my own county are being deserted. I have in my desk at home returns from the town clerk of every town in that county, and in the whole county there were but two farms which had been abandoned; and the appearance of the farms themselves which are being carried on there, and which are devoted to specialties and carefully cultivated, indicates

everywhere a degree of prosperity of which the farmer ought to be proud.

I make these remarks because I am a little tired, going about as I do among the farm-houses and among the farmers, and witnessing the prosperity and uniform general contentment of the farmers themselves, and the good appearance of their buildings and land, — I am a little tired, I say, of hearing the farmers of Massachusetts so continually reflected upon, and having the charge thrown in their faces that they are abandoning the homes of their fathers. There is no occasion for any comparison, — not the slightest. Farming is a business which goes up and goes down everywhere. It oscillates, like every other business. There are many mills in Massachusetts to-day that are not making a profit; but they will come up again, they will revive; and, if any farmer is compelled to suspend his operations for a season, and wait for the new day to dawn, that day will as surely come as he is capable of waiting patiently for it.

I am happy of this opportunity to say this word or two, which I have said much more elaborately elsewhere, with regard to farming in our own section; because this is perhaps one of the last meetings of the Board that I shall be able to attend, as my term of office expires in February, and I shall undoubtedly be relegated to private life. But however that may be, I have said this as a parting word, to show my faith in the farming of the section of the country in which I live.

Mr. Lynde. I would like to ask if it would be any advantage to those who are engaged in farming to have agriculture encouraged in the schools? Have we not competition enough now? In other words, are the boys who leave the farms and go to the cities any damage to the boys who remain at home on the farm?

Dr. Twitchell. It is not competition we need, but intelligence. I care not how much we have, we want more of it. I do not urge agricultural education in the schools, pure and simple, but I do urge the inculcation of a love of natural things, which will give a boy, if he has a love for agriculture, a better knowledge how to do the work essential to success. Give the children a knowledge of those natural

things which they are handling every day in their lives. If they go to the cities, they will make better lawyers, better manufacturers, and those who have a love for agriculture will make better farmers.

Mr. FITCH. Is the competition of the farm products of the West an injury rather than a benefit to the New England farmer who is obliged to compete with his neighbors?

Dr. TWITCHELL. I say it is a benefit, because, unless pressure is brought to bear on a man, he will never be developed.

Mr. FITCH. I find I neglected to answer one question suggested by the lecturer. He asked whether the farmers were giving up, or whether it was by their neglect that the Union was not doing all it might do. The point is this. A great many farmers are folding their arms, and crying out to the grange, to this Board, to every place in creation, "Help us!" They are willing to be helped. It is time they were willing to help themselves. Perhaps a quarter of the members of the Milk Producers' Union, which numbers about fifteen hundred men, have not during the last year and a half paid their dues. Why? Many of them have said, "The Union will fix the price of milk, whether I pay my dues or not." They were willing to be helped, but were not willing to do anything themselves. Others have stayed outside, have not joined the Union, because, as they have said, they could conduct their own business.

Governor HOARD. I would like to say a word or two, if you will allow me. Dr. Loring has spoken of the abandonment of New England farms. I want to assure you that this problem is just as serious in Wisconsin as it is in New England The difficulty with us all through the United States is the abandonment of the farmer, not the abandonment of the farm. Why, we have some men in Wisconsin who are absolutely committed to the abandonment of all that is intelligent and sensible. I have a hundred and twenty-four patrons in one of my creameries, and I have studied those men as I never studied anything in my life. I want to give you, in just a moment, a sharp, clear-cut object lesson. We take in that creamery the milk from a hundred

and twenty-four men, separate it, manufacture it, market the butter, and charge them four cents a pound. We have been enabled to secure the very best market of any creamery in that section, thus enhancing their returns. Now, the same sky is above these men, the same soil beneath them, the same market in front of them, and the same creamery behind them. But what is the difference? At the head of that list stands a man by the name of McPherson, with thirty-five cows. I paid him last year sixty-three dollars and fifty-one cents for the earnings of each of those cows, and he had the skim-milk beside. I have paid him as high as seventy dollars. At the foot of the list is a man to whom I paid forty dollars last year, and I have paid him thirty-five dollars. He has twenty cows. He is troubled with abandonment. I tell you there is nothing under God's heaven that will help that man except a funeral. He is a gone case. Now, the first man was intelligent enough twelve years ago to look into this matter. He came into my office one day, and said, "I have got tired of keeping cows that make only one hundred and fifty pounds of butter apiece; what shall I do?" I said, "McPherson, I am glad to hear you say that; we will study it together." He had a herd of grade Shorthorns, and they were giving him one hundred and fifty pounds of butter apiece a year. If he undertook to crowd them any more, he crowded the whole thing into flesh. I said, "Let us get a good herd of cows," and so we went at it. The result is that he has a herd of cows to-day that make an average of over three hundred pounds of butter per cow, and there is not a penny of additional cost for the support of the bodies of those cows; I doubt very much if they cost so much. The old herd averaged about eleven hundred pounds, and his present herd average about eight hundred and fifty or nine hundred. Now, it cost this other man that got only forty dollars a head thirty dollars to keep his cows. I have every item of that man's expenses and history. It did not cost very much investigation to get it.

Question. Have you got his pedigree?

Governor Hoard. He is a scrub, and a scrub has no record. Now, I never talked so sharply to any other man as I have to him. He has left that creamery half a dozen times.

I have said, "Go! Go! You are joined to your idols. Go, and don't come back. Don't bring your milk here. You are absolutely abandoned, and disgrace this institution, and you know it." But the man would come back and say, "I want to sell you my milk; I can't do anything with it." One day he said, "If I undertake to make butter, nobody will buy it." I said, "You are right." Now, that man represents a large number of men in Wisconsin, and represents a large number of men everywhere. It is shiftlessness, not a keen, sharp recognition of amenability to the law of one's environment. It cost that man thirty dollars a year to keep his cows, and he got a margin of ten dollars. It cost the other man I will say forty dollars, and he got a margin of twenty-three dollars, and the skim-milk was returned. I would pay McPherson fifteen dollars a head for his skim-milk. His cows average over six thousand pounds of milk apiece. He is intelligent enough to be a winter dairyman, and makes his milk when it is worth the most. The other man is a summer dairyman, and makes it when it is cheapest.

This difficulty confronts us in Wisconsin as it does you. It reminds me of that good old hymn, "From Greenland's Icy Mountains." You remember the verse, —

> "Where every prospect pleases,
> And only man is vile."

Mr. Bela J. Stone. I would like to ask how that man improved his herd? What cows did he breed from, in place of the grade Shorthorns? I would like to ask also whether the governor pays the same price per hundred pounds for all the milk.

Governor Hoard. I have no time to go into a long explanation. I think our creamery was the first in the United States to undertake to solve this problem of pooling. We separate the milk by a centrifugal separator. We have what we call the Jersey vat, and another that we call the common vat. We have a large number of high Jersey and Guernsey grades around Fort Atkinson, and we made a provision that all the milk from cows with fifty per cent Jersey or Guernsey blood should go into the Jersey vat,

and that the common milk should go into the common vat. There is a certain injustice in that. There were certain cows in those common herds that gave just as rich milk as the others, but we had to strike some line. We conduct the business in that way. I have been trying to instruct those people for twenty years to improve their fortunes by improving their cows. That man of whom I spoke brought his herd of cows up from one hundred and fifty pounds to three hundred and fifty-seven; and he did it first by breeding, secondly by feeding, and thirdly by handling. Those three things, as I said last night to you, constitute the sum total of the dairy gospel. But these men that we are bothered with, these men who keep back the salvation of God, these men who cause the church to mourn, these men who will not attend the dairy meetings, these men who refuse to be known as dairy Christians, — I don't know of anything that will move them, unless it is, as I said a few moments ago, a funeral. Their eyes are set. I have given them up. I had much rather take one of their boys.

Now, we have a large number of Germans. Seventy per cent of the population of my county is German. They are of such quality and character that if we can get hold of them it helps. I will give you one little story. About thirteen or fourteen years ago a German came to me; I will call him Karl Streider. He came into my office and he said: "I hear you talk so much dairy. I have got my sixty acre land; I get my milk, big milk, on that land, and I don't know what I do. I feel I work, I work so hard, — mine Gott, I can't help myself; and I think maybe if I was in the dairy pezness that would help me a little." Well, the simple, kindly appeal of the man touched my heart. I said, "Karl, we will try; we will take hold of it. There is always good, hard sense to be used in making a man's fortune." Karl said, "I have got me no money; I can't go into the dairy pezness that way; I can't buy this thing and buy that thing." I said, "How many cows have you got, Karl?" This is a simple story, commencing at hard-pan, and I want it to carry a lesson. He said: "I have got nine cows, and I sell my butter in the town to the store-keeper. He stick

up his hands and he say, 'That more stinks as butter,' and that makes me discouraged. I don't know what I do." I said: "Look here, Karl. The difficulty is, you have never thought that butter is the product of the highest skill; you have sold no skill. You are like a thousand other farmers, who never think for a moment that they can sell skill. We will correct that. You have got money enough to buy two kerosene barrels." I knew I had got down to the very bottom facts of that man's fortune. "Surely," he said. I said: "They will cost you a dollar and twenty cents. Burn out the oil, then buy five dollars' worth of lumber, and build a rude shanty over them. Then go and buy some shotgun cans down at the tinsmith's, and put your milk in them, and, instead of keeping your milk in the house, fill those barrels with water, and put the cans in them. Your wife has been setting the milk in the house, and the smell of the cooking and all the smells of wash-day go into your butter." Well, the result of it was, that he started in at an expense of about fifteen dollars. He told me his wife kept saying, "Karl, that Yankee is a humbug;" but he kept on, and when the time came he took off his coat, churned the butter, put it up in a twenty-pound package, and brought the package to me. I tasted the butter and sent it to a commission man in Chicago, with a letter in which I said: "These are the first fruits of righteousness from my friend Karl Streider. Sell this butter for what it is worth, — I know it is good butter, — and send me the account of sales and your check." It sold for twenty-four cents a pound. Butter was selling in the cross-road markets at that time for about fourteen or sixteen cents. I drove down to that little Dutchman's house, and I tell you, my dear friends, I never felt better in all my life than when I took that check in and said, "Karl, there is your money for that tub of butter, — twenty pounds, — twenty-four cents a pound." It was a light that broke through the woods. "Twenty-four cents a pound!" he said, "Mine Gott!" He looked at the check, and then caught his wife about the waist, and, with the check uplifted, went waltzing round the floor, exclaiming, "Lusette! Lusette! Mine Gott! that is no humbug." That man is worth to-day somewhere in the neighborhood of fifteen or

twenty thousand dollars, with a two-hundred-acre farm and seventy or eighty cows; and every little while he sends me a tub of butter and says, "To my good friend, who showed me how." Now, there are hundreds of such instances that have come under my own observation. My friends, that system can be just as profitably employed in New England as it can in Wisconsin. We do not differ so much as the stars in glory. Our interests are about alike, and all blessed influences will act alike upon the one and the other.

Mr. W. W. Rawson. I have been referred to in some of the remarks which have been made as being one of the market gardeners. Of course, being interested in that business, I know what concentration means, not only in market gardening, but in all kinds of farming. The reason why a good many farms are deserted, is because they are not worth cultivating. There is no such thing to-day as overproduction in Massachusetts. I thought a few years ago, when I first launched out in the market gardening business, that there might be such a thing; but I doubled my business, and found I did all the better. There was a time when we thought we could not raise lettuce for less than a dollar per dozen; now I should be very glad to get fifty cents. There was a time when we thought we could not grow it in hot-houses, but were obliged to grow it under glass outside. That has all been done away with. It took me seven years to get there. You have been given to understand how this thing has been accomplished. It has been accomplished by patience, by constant work, and by study. Study your business, understand the land that you cultivate, get all the information you can in relation to the business that you are carrying on, and make a specialty of some few articles, because any one of the articles that you might produce at the present time will give you a living. I am carrying on at this present time three distinct businesses, and any one of them will give me a good living at any time.

The young men of to-day, I think, have a better chance than the young men of ten or twenty years ago, even in farming. They have opportunities to-day for acquiring knowledge which some of us did not have ten or twenty

years ago. They have the land which is at their disposal, they have the markets, which you all know are the best in the world. There is no such market in this country or in any other country as the Boston market, and there are no such vegetables or produce of any kind shown in the market anywhere, or shown in such good shape, as in the Boston market. All of you know that, and I would advise you to take the advice of one of the speakers here, and go to the Boston market once in a while yourselves. I go there every day.

I do not wish to take up the time, Mr Chairman. I think that the trouble in most cases with farming at the present time is with the man, not with the farm. All it requires is intelligence, brains and capital.

Mr. Peterson. I would like to inquire, of those who have the figures, if within the last seventy-five years farming lands in New England were ever cheaper in price than they are to-day.

Dr. Twitchell. I cannot answer the gentleman's question, save so far as it relates to my own State, except that the remark has been made, by some of those who are gathering statistics in other States, that farm property has never been so cheap as to-day. It is so in the State of Maine, outside of Aroostook County. There farm property was never so high as it is at the present time; and in certain sections of the State, where special work is being done and special results obtained, the same condition of things exists. But general farm property is low in Maine, low in New Hampshire; and I judge, from the papers I receive from your own State, that it is low in Massachusetts.

Recess until two o'clock.

## Afternoon Session.

The meeting re-assembled soon after two o'clock, Mr. Hartshorn in the chair.

Secretary Sessions. I have a question here that need not take any great length of time in discussion: "Must we cement our barn cellars in order to save the liquid manure

in the best possible manner?" I will call upon Mr. Sage of New Braintree to give his opinion upon that.

Mr. SAGE. I think, under ordinary circumstances, it would hardly be necessary to cement a barn cellar. It may be well enough for fancy farmers, where they have plenty of money to do it; but ordinarily I think if our farmers will cart in enough absorbents to take up the liquid that accumulates in the barn cellar, it will be all that can reasonably be expected.

Mr. THOMPSON. My barn cellar is cemented on the bottom, but not on the sides. I find that, if I am not very careful to bank up on the sides, the liquid will begin to run out very soon. I think, if we want to save all the liquid, we should cement both the bottom and sides, and have the cellar perfectly water-tight.

Secretary SESSIONS. We would like to hear a word from Mr. Newhall on this important question.

Mr. NEWHALL. As far as concerns my own cellar, I do not think it is necessary to cement it. The soil is a compact hard-pan. We use a large amount of absorbents, and in the spring we have to draw out a great deal of liquid. We go in with a cart with a large hogshead on it, and draw it out. I do not think it leaks at all without any cement.

Mr. HOWE. I would suggest that George Marsh of Dudley is able to give you information on this subject. He has had large experience.

Mr. GEORGE MARSH of Dudley. My way of handling the liquid manure for the last five or six years has been by running it off into a cistern outside of my barn cellar. The cistern is large enough to hold the accumulations of a year, and about the last of May or the first of June I use it for top-dressing my grass land. I have not been able to apply anything that shows so plainly where it was placed as this liquid manure.

QUESTION. Do you use a sprinkler to put it on with?

Mr. MARSH. I take the body off of my cart, and I have built a platform some six feet in width which I put on the wheels, and on this platform I have a large hogshead which holds perhaps as much as two or three ordinary hogsheads. I cart out the liquid in that way. That hogshead has a

bung-hole perhaps two or three inches in diameter. I have a contrivance inside of the hogshead by which I regulate the discharge. As the liquid goes down, I open the bung-hole wider. There is no stopping; everything that will run distributes all right.

Secretary SESSIONS. Shall we hear a word from Secretary Bachelder of New Hampshire, on this point?

Secretary BACHELDER. I agree with the previous speakers, that, if a sufficient amount of absorbents be used in the stable, we shall save practically all of the liquid manure. I practice hauling soil into the cellars after they have been cleaned out, both in the spring and in the fall; and that, with the other absorbents, I think saves nearly all the liquid.

Secretary SESSIONS. I have a cellar, and practice the method that all these gentlemen, with the exception of Mr. Marsh, have suggested; but I believe, if I were to build a barn again, I should build it so that I could drive a team through behind my cows every morning, and take the manure to the fields every day throughout the year, and distribute it where I wanted it. In this way I should save a great amount of labor in handling the absorbents. My observation has led me to the conclusion that, although we may have a barn cellar and all the fixtures, we do not get the full value of our manure.

QUESTION. I would like to ask Mr. Marsh the expense of the tank he uses for holding the urine.

Mr. MARSH. I did not keep an exact account. I estimated it at about $150. It is built of stone and brick, nineteen feet in diameter, and eleven feet deep.

The CHAIRMAN. The subject for the afternoon lecture is "Law, or Nature's Modes of Action," by Prof. I. P. Roberts of Ithaca, N. Y.

## LAW, OR NATURE'S MODES OF ACTION.

BY PROF. I. P. ROBERTS, DIRECTOR CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION.

MR. PRESIDENT AND GENTLEMEN: — I speak from the sincerity of my heart, when I say that it gives me great pleasure to come down to New England. There are two

places on the globe that from time immemorial I wanted to know more about. One place was New Orleans, and the other place was New England. When I was a boy I took Horace Greeley's advice, and went West. I have wrestled with the gentle zephyrs of Iowa many a day, and I learned some valuable lessons in that far-off country. I have returned to New York State, but there I have learned but little of New England. For forty years I waited to see New Orleans, and I have waited sixty years to find out something about New England.

I felt that your Secretary was kind when he sent me an invitation to address the leading agriculturists of this great Commonwealth; he was kinder, when he intimated that I would be expected to speak not more than thirty minutes; but kindest, when he said that time would be given for questions and discussions after the paper was read; for now I have but to set the stakes, strike out the lands, and then we will all "set to," and plough out the middles.

During the decades from 1840 to 1860 agriculture was greatly depressed. Our inherited, unrestrained desire for land resulted in destroying the forests on millions of acres of steep hill-sides and sandy plains, which contained but little fertility, and which could yield remunerative returns at best for only brief periods. The cities were small and few; the wants of the consumers were simple, and easily satisfied; producers were many; the home market glutted; the foreign, distant and expensive to reach.

Corn and oats in Illinois and Iowa in some of these years could with difficulty find a market at from ten to twelve cents per bushel, many other products were correspondingly low. Wild-cat money and bad banking laws in many of the States resulted in giving the people a currency in which few had confidence, and which could be used outside of the State in which it was issued only at a ruinous discount. Government was borrowing money at twelve per cent, individuals at still higher rates. Carpenters and masons received from one dollar and fifty cents to one dollar and seventy-five cents, farm hands (except in harvest) fifty cents to seventy-five cents per day, and board. In the midst of these difficulties, taking no thought for the future, we went

on clearing and improving, at vast expense of energy, large tracts of land which could only be cultivated at a positive loss. At least one-third of all the cleared lands in New England should never have been improved. Left in timber, an annual harvest could have been secured and large profits realized from this land, which has not given a clear dollar since the last brush heap was burned.

All of our troubles and difficulties come from the transgression of law: laws of agriculture, laws of forestry, laws of springs and brooks, laws of supply, laws of fertility and of plants for it, laws of economy, laws of energy and work, laws of education, laws of finance.

The Northern farm boy studied Hebrew, and shut his eyes to the rape which was being committed on mother earth, when he should have studied how plants and animals grow and feed and live. The Southern boy studied Latin when he should have been studying chemistry, not dreaming that millions of value lay rotting and wasting in the neglected cotton seed and behind the old gin-house.

The next decade was ushered in with cannon filled to the mouth with deadly shot and shell. Their reverberations proclaimed to all the world that another of nature's laws had been broken, and that the penalty was about to fall. Large numbers of producers were quickly converted into consumers; prices reached high-water mark, inventive genius saw its opportunity. The farmer had two cultivators, and but one man to use them. With a few bolts and bars they were united, and the productive power of the corn grower was more than doubled. Efficiency was increased tenfold by substituting the two-horse for the hand-planter. Headers, binders and gang ploughs enabled each man to produce six times as much wheat as he could by the old method.

The war closed, consumers were again transformed into producers. An abundant currency, phenomenal increase in the number and size of the cities, extension of railways and unbounded faith in the future, caused prices for land and its products to recede slowly from their lofty heights. Meantime, new lands were opened up in forest and prairie with unabated energy, and depletion of soil fertility was still

further accelerated. Few stopped to consider the penalty which must sooner or later attach to the transgression of the first great laws of agriculture.

Every million bushels of wheat, with the accompanying straw, removed from the land $402,900 worth of potash, nitrogen and phosphoric acid; and the 490,000,000 bushels raised last year represented $197,421,000 worth of these three prime elements of plant growth A conservative estimate would put the amount of these elements carried back to the field at not more than one-fourth of the amount removed by the wheat and straw. Is it any wonder that the exacting wheat plant moves its habitat westward, to escape the penalty of the transgression of the laws which govern its successful cultivation?

Many have broken the laws of pomology, and numberless starving orchards furnish "nothing but leaves," and these scarcely sufficient for the vast broods of Lepidoptera and Coleoptera which infest them. When we consider the vast variety and quantity of farm products which have been removed from the fields of New England in the last hundred years, we are led to conclude that the description of some of the earlier discoverers of the beauty and fertility of "the New England" was not greatly exaggerated.

By this array of discouraging facts it is not meant to find fault, or to cast blame on our ancestors. Many well-kept, fertile fields, numerous stately farm-houses in which dwell refinement and plenty, testify to their intelligence, courage, wisdom and success. They did nobly; it is unnecessary to speak of their heroic deeds here and now, for annually at every New England Thanksgiving dinner their virtues are justly lauded and their bravery set forth in story and in song. But they made many mistakes, they broke many laws, they set nature's mode of action at defiance. They said, "Let us go to now, and rear many plants and animals, that we may have good things in store, and let those who come after us raise plants too, if they can, or 'go West.'" They should have said, "Let us go to now, and study the laws of nature, that we may work in harmony with them, and raise plants to feed animals to make fertility, to feed other plants, to feed other animals, to make more fertility."

The few ounces of dry matter which the human body requires daily will hardly be missed from the vast stores of the earth, if fertility is conserved agreeable with nature's laws. If the rocks do not give up their stores fast enough to keep up the slight necessary drain on the fertility, then we will dig in the bowels of the earth for the lacking minerals, and set the microbes round about the clover roots, and make for them a fit dwelling place in the mellow soil, so that they may seize upon and combine the nitrogen of the air, thereby saving the land from barrenness.

There is not time to go into all the details of the better methods by which advancement is to be made, but some of the more common ones might be enumerated. Labor and fertility should be concentrated on the better lands, and those which cannot be cultivated at a profit under present conditions should be left for pasturage and forestry. It is certainly the part of wisdom to give back to the forests their own, and it is no reproach to agriculture to acknowledge that we have made mistakes. Starting, then, from the new basis, we are to do those things which are difficult, and produce those things which are high priced, and which require the maximum of skill and the minimum of toil. More clear money can be realized from a rod of mushrooms than from five acres of corn, provided the requisite knowledge is applied to their production. Mushrooms are seventy-five cents, corn one cent, per pound. Butter at five cents weighs sixteen ounces to the pound, at thirty cents it weighs no more. Quality, not quantity, is what is now lacking. Better quality means better skill, fuller knowledge, more and better food for plant and animal. As no nation has ever become highly refined without a varied and appetizing diet, so no animal or plant has ever been improved without improving its food and environment.

The food supply with which we have to do lies, primarily, mainly in the soil; the problem is, how to get it out so that it may rotate around the circle of plant, animal and soil. If this be so, then our first study must be how to make the elements in the soil available, and, I may say, palatable as well. The plant asks for food, and we too often give it clods and stones; it asks for a fine, fairly compact soil, and

we give hard-pan or ashy looseness. Water cannot rise and fall in the one, because of the few capillary channels; nor in the other, because the channels are too large. It asks for a full ration, and is given but half.

Suppose we go to some primitive fertile forest, where the axe and firebrand have not made havoc, and where half-civilized man "with gun and dog impatient at the shot," has not desolated the field, and study the evidences of Nature's obedience to law, written in soil and plant. Countless plants both great and small furnish food for birds and beasts innumerable. The rich, fine, compact soil, filled with decayed and decaying vegetable matter, covered during the winter, furnishes the ideal conditions for plant growth. Here all refuse material is husbanded and used for production the succeeding year, and is as unlike the liquid streams of manure which escape from flooded barnyards and neglected manure heaps as the practices of husbandry are unlike the laws of agriculture.

With plough and cultivator and right to dominion, with God-given and God-like powers, knowledge and skill, we are to begin the work of improvement. We are to select the best and destroy the poorest; *this is the law.* We are to do more: we are to make that which was best, better; *we are to assist, accelerate and direct the laws of evolution.* We are to command with understanding, in order that we may be obeyed with alacrity. We are here to make things more comfortable for plant, animal and man, to prepare the way for that which is to follow; we are to waste nothing, but are to enter into our usufruct right to all the earth, in order that all that is worthy may have abundant opportunity to arrive at its best estate. How are plants and animals to be improved, if not by destroying the poorer and by making it more comfortable for the better? This is nature's mode in forest and on prairie.

Have we reached the limit of profitable improvement? Is eleven and one-tenth bushels of wheat per acre, in the United States, in 1889, the most profitable yield? Is twenty-seven bushels of corn per acre the limit of the law of production of the most common cereal in the country? On 78,019,651 acres, 2,112,892,000 bushels of corn! It must strike a

student of political economy that there could not have been much economy of that American boy's legs, when he traveled in many cases thirty miles for each acre of corn, of which the fathers are so proud.

How many farmers of this State have made an intelligent effort in the last five years to improve the seeds of their leading crops? Are we not prone to employ some one else to do this high-class labor for us, and to be content to pay them one thousand per cent more than ordinary prices, for the little sack of seed which may or may not be better than the "scrub" variety we already possess? You will perceive that I am striking out many lands; if the stakes have not been set straight, we shall have to go back and line them up later.

It appears to me that, as a people, we have made but little effort to discover the laws which govern our profession. Our conditions until recently have been peculiar, and abnormally favorable, so that we have naturally gone on practicing *imitative* agriculture. Too many of us have milked the cows as long as *they* chose to give milk, instead of commanding them to give milk as long as *we* chose. The manure of the animals, which is worth half the cost of the food fed to them, we still continue to baptize under the eaves, because our ancestors did. We wait each succeeding spring for opportunity to thrust in the plough, when we should have made opportunity by thrusting in drain tile.

If we get on well in the future, we will be compelled to go according to law; which is, in agriculture, "Science practically applied within the sphere of the law which governs it." The locomotive engineer runs his engine and train according to the law of railways; if he proceeds according to the law of steamboats, and attempts to cross a river without a bridge, he will come to grief. How many farmers are practicing better methods, or are planting better varieties of corn, than did Capt. John Smith? Some are, but many are doing hardly as well as he did. He imitated the Indians, we feebly imitate Smith. Our occupation is to produce growth and advanced development, and this is but change in forms of matter according to the laws of life. The change from dead earthy matter to living plant forms

is most perfect where fine, compact, rich soil is found. If one or more of these factors are wanting, nature requires that a second or third rate plant be grown; but the farmer can only afford to raise the highest class of plants. How nicely nature selects and adapts herself to the prevailing conditions: the cat-tail for the marsh, the oak for the hill-side, the mullein and daisy for the old worn-out sheep pasture! All these hints should lead us to study more closely nature's modes of action; having learned these, we are to make them more useful and more effective, by removing or arresting antagonistic forces, in order that the operation of the law may expend its full energy in producing the most useful results.

We hurl maledictions at the poor cows, which constitute more than one-half of the whole number; this is all wrong, for they are just as good as they can be; the leopard cannot change its spots, nor the dairy cow its udder. Man, who was given dominion over every living thing, must make the changes, if they are made. All plants and animals are simply the living registers of the average knowledge and skill of those who have propagated them. Nothing can grow better without improving the conditions under which it exists. If better animals are purchased with which to improve the poorer, and the conditions of the offspring are not made better than were the conditions of the poorer variety, they will take the first opportunity to adjust themselves to their environment; or, in other words, they will sink to the level of their poorer ancestors, and the grade will become a "scrub." Just here is found the cause of so many failures. The attempt is made to breed better animals according to the law of the poorer ones. Our best animals are the progeny of those which served in a very imperfect manner the wants of civilized man; they were made better by *food*, *comfort* and *habit*. If the dairyman feeds his cows on timothy hay and a small quantity of dry old grain, limits their drink, and exercises them vigorously for two or three hours per day, in a few generations he can have cows, steers and heifers which at short distance will rival the speed of well-bred horses. Is it wise to conduct the dairy according to the laws of the trotting stable? Suppose

the law of the dairy is applied to the breeding of thoroughbreds, — the animals given all the clover hay they will eat, supplemented with a goodly allowance of green silage, pumpkins, mangolds, malt sprouts, brewers' grains, cotton, linseed and Buffalo meal, and sixty to eighty pounds of warm water per day, and are given little or no exercise, but coaxed to spend most of their time on comfortable beds, — which would run the faster, the thoroughbred reared according to the law of the dairy, or the steer reared according to the law of the thoroughbred?

It has been proven, time and again, that comfort or congenial conditions, as well as food, play an important part not only in the direction of the growth, but in the character of the living tissues. Tough or tender celery or asparagus, beef and mutton, according to condition and nutrients, can be produced at pleasure.

No less potent are the laws of habit; the brain and the hand trained to work in one direction adapt themselves with difficulty to unaccustomed lines of work; the type-setter makes but an indifferent carpenter, and the book-keeper a poor farmer. The dairy cow is an unprofitable beefer, and the beefer an unprofitable milker; the thoroughbred is restive at slow, hard work, while the draft horse is a failure when used according to the law of roadsters.

We find, then, that, while size and proportion have much to do with the economical direction of energy, habit has more. The cells of which the living tissues are composed, having been long accustomed to using their energies in a few well-defined directions, do not respond quickly when directed into new and unaccustomed channels. The breeds which have been bred for long periods for special purposes have made a law unto themselves, and that, the very best, consistent with the food, conditions and habits of themselves and their ancestors; that is to say, they have grown just as good as they could. How may they be improved? By improving all that goes to make up their lives, and by taking advantage of the results of the knowledge of the wise and successful who have preceded us. Let us not be deceived into the belief that all we have to do is to seek, in some far-off country, one or more superior animals to accomplish our purposes.

It is true that the progeny of superior animals, or plants, may, and usually do, rise above their inferior conditions; but it is only a matter of time when they will find the level of these conditions. Like the impetuous mountain stream, which continues to flow for a space after it has found its level, from the impetus acquired under other conditions, it tends to come to rest on the first level, and remains obedient to the law of that level. Then the level must be changed, or the stream must be urged on by a never-ceasing supply of water containing the energy of the mountain, if work is to be done. We have generally practiced the latter and more expensive method in uplifting our domestic animals. We are importing no fine-wooled sheep and few swine and chickens, simply because the level of the conditions are above those in which these varieties of animals were originated. It appears to me that we have the foundation stock, and all we have to do is to uplift the conditions and accelerate improvement by rigid selection, and form specialized permanent habits for specialized work, always using good judgment, so as not to carry the law of improvement beyond its most useful sphere of action. The fact should always be kept clearly in mind, that specialized qualities are secured somewhat at the expense of other qualities; and that it is quite possible to develop the udder to such an extent that it will detract to a serious degree from the organs which are necessary to existence and vigorous health. This has been the case with some of the noted strains of milkers, which had the milking habit so firmly fixed that it dominated the one of self-preservation; so that, when nutriment and comfort were insufficient, the animal kept on giving milk at the expense of its necessary reserved vital force, thus reversing the operations of the law, which are first, self-preservation; second, offspring; and third, surplus. All law should be used lawfully.

The law that governs water, the vehicle which transports the energy of the soil into and through the plant and animal, and the harmonious operation of this law in conjunction with the law of nutriment, should receive our careful attention. As water is the substance which carries all food for plants and animals into and out of circulation, it becomes

of the utmost importance. If the laws which govern all else be practically known, and the knowledge of the part which water plays in growth and production be wanting, our efforts will not reach the highest success. It is not enough that water is present in suitable quantities, it must be palatable and easily accessible; just enough, and not too much. Better a shortage of food than of water, better irregularity in feeding than in watering; for, if the ration be temporarily deficient, and the vehicle for transporting the reserve stored in the system be present, no great harm will result; but, no matter how much nutriment may be stored or otherwise present, if the universal carrier, water, is lacking, not only can no work of nutrition be done, but the system immediately becomes feverish and diseased. So to the dairyman I may say that if his herd, however poor, is made uncomfortable because of coldness or poorness or inaccessibility of the water supply, he had better study hydraulics before purchasing thoroughbreds. And to the grain raiser I might say that he had better pay strict attention to setting free more plant food by better culture, and to husbanding farm manures, before investing in commercial fertilizers; for possibly, if he utilizes what he already has, according to law, he will have little lack. And to all breeders and cultivators of plants may I not say that it might be better to make it more comfortable for the plants and animals which are already possessed, in order that they may make the best use of the operations of the laws which govern them, whether they be scrub or thoroughbred, before purchasing that which is too advanced for our present state of knowledge? It is possible that a part of what we have is good and that all that is lacking is opportunity. As the stream cannot rise above its source, so the animal cannot be better than its breeder. And to the breeders of thoroughbreds I may say, that it might be well to adopt the practice of that great Short-horn breeder, Mr. Bates, — "never to sell a good animal to a careless farmer."

The Chairman. The professor told us in his opening remarks that he was merely going to drive in a few stakes and strike out a few furrows, and you were to set to and

plough the middles later. It seems to me he has struck out some large lands, and, in order to have the work completed to-night, I think you will have to question the professor pretty sharp and close.

Mr. L. W. West of Hadley. I would like to ask the best arrangement for heating water for cattle.

Professor Roberts. Of course most large barns have a small engine and boiler. In case you do not have these, have a tin cylinder eighteen inches in diameter and eight inches deep, made water-tight, with a little smoke-stack four inches in diameter protruding out of it, and another place to feed in chips, about six to eight inches in diameter, which shall be a little lower than the smoke-stack. This is surrounded by a rim, so that there shall always be water around the cylinder. The whole thing should be covered and fastened in one corner of the water tank, so that it cannot be knocked over by the cattle. This arrangement has been used in Nebraska with very good results; so good that we have had a little model made of it which we exhibit at institutes. The water can be cheaply and easily warmed in this way.

Mr. Ware. I am very glad of what has been developed here with regard to warming water. I have seen a good many arrangements for warming water for stock, which were simply designed, as was claimed, to "take the chill off." I have heard of cases where that has been done, and the farmers have felt that they did not gain anything specially from it. Now I learn from the professor that water slightly warmed is rather objectionable, — I should think possibly it might be, it certainly is unpalatable,— and he advocates heating the water to ninety degrees. It strikes me that that is a departure from the advice that we have previously had. I have seen an apparatus on our cattle fair ground for taking the chill off by passing a pipe through a large trough of water. I think this idea of making the water hot is an important one. I would like to hear from any gentlemen here who have had experience in using water with the chill taken off, how they like it, whether it has proved profitable to them; and, if there is anyone here who has used hot water, I would be glad to know the results of that experience.

Professor ROBERTS. I recommended the use of hot water for cattle sixteen years ago, before our State Dairymen's Association at Norwich, N.Y., and got hissed off the stage. Then, at a great banquet that night in the basement of the Baptist Church, I got toasted in *hot water*. We commenced warming the water for our cattle as an experiment, and we found that the warmer we got it the better the animals liked it, until we got it up to ninety degrees. If we got it hotter than that they would put their noses into it, draw back, throw their heads up, and then drink slowly; but in the course of a week our cows got so they refused any but hot water. We have made some careful experiments, and find that we save about fourteen per cent of the food by giving the animal hot water. Some have made experiments with better results than this. I know that our cattle like hot water a great deal better than cold.

Mr. WARE. You have objected to lukewarm water, — why?

Professor ROBERTS. I will tell you the reason I have objected to it. I have learned of the cow. I just ask her the question, and she says, "I want my water hot." I say, "All right; you know best."

Mr. B. J. STONE. If you had water under cover, and there was no ice on it, would there be any advantage in warming it?

Professor ROBERTS. I think there would be a very great advantage. We have the water for our cattle under cover.

Mr. STONE. I find that when I feed my cows dry food they will drink twice a day and drink largely, and your remark of their needing so much water to properly digest their food struck me. My practice most of the time is to feed moist food and steamed food, so that I have a boiler; and I find the cows do not care to drink a great deal of water, not more than one-half or one-quarter what they drink when they are fed with dry food. Sometimes they will drink only every other day. I water them but once a day. I would like to know whether I am losing anything by not getting so much water into them. I cannot see any decrease in their milk by their drinking less, in comparison

with what they gave when they were eating dry food and drinking a large amount of water. I want to know whether the moist food does them as much good as dry food, and drinking a large amount of water.

Professor ROBERTS. Certainly, when the food is moist they will not drink so much water. If you give them cold water, you have got to burn hay and corn to warm it.

Mr. STONE. It does not take much corn or cotton-seed meal, if you make your food moist, to warm it.

Mr. NEWHALL. I have had some experience in this matter. I have had a heater made by the Ericsson Company of Brattleboro, Vt., that I like as well as anything I have seen. I believe it pays me. I think it saves me at least ten dollars a year in the time that I would otherwise have to spend in watering my cattle. We all know that cows are very sensitive to cold water. If you take out a lot of young cows, they will dip their noses into the water, throw their heads up, and very often it is ten or fifteen minutes before they can make up their minds to drink that cold water. This heater only takes a handful of waste wood to heat the water. It is seven feet long. If the water is frozen over in the morning an inch thick, I build a little fire under it, and when I come out from feeding, the ice is all gone and the cattle will drink that water just as quickly as they would on a warm morning in July. I have never tested it to find out exactly how much difference it made, but I think it would pay me to buy one every year. I water my young cattle only once a day. They will go out and drink the cold water, and you will hear the barn shake, they are so full of ice water when they go back. It is just so with the cows. If they go out and drink all the cold water they want, they will tremble as if they had the palsy. I have made up my mind that it does not take nearly as much food for my cows when I warm their water, as when they have it cold. I do not warm it up, probably, as hot as the professor suggests, but pretty near, — what I should call milk-warm.

Mr. EVERETT. I think not one in ten of the farmers of Massachusetts have ever heard of heating water so hot as the professor has suggested. At any rate, I never have. But taking the chill from the water has been practiced by a good

many milkmen in this county and in the State. My cows last winter would go to drink and put their noses in the cold water and throw them up, and I had one cow that would not drink for from a quarter of an hour to twenty minutes, and then not nearly as much as she would if the chill had been taken from that water. I think that cold water, if taken into the system, prevents the animal from assimilating its food properly. I believe that the chill should be taken from it, but it does not seem to me that it can be practicable for farmers generally to heat the water to the degree which has been suggested.

Professor ROBERTS. I presume, gentlemen, you want your tea and coffee more than lukewarm, and my word for it, your cows are just like yourselves. It is all on the same principle, according to the same law. We have been all over this thing, tested it and tested it, and we know that a cow likes water a great deal better when it is about ninety degrees, than at a lower temperature.

Mr. S. A. NEWTON of Auburn. Do you warm the water in the summer season, or only in cold weather? Our running water is below ninety degrees in the warmest weather, and, if it is worth while in the winter to heat it to that particular temperature, why not in the summer?

Professor ROBERTS. Because the cow gets too hot in the summer, and she likes to have something that will use up the superfluous heat. In the winter she has not that superfluous heat, and wants her water quite warm.

Mr. NEWTON. Why not heat the water above ninety degrees? It seems to me you have not got it up to what will be really palatable. Certainly to a man it would be rather lukewarm at ninety degrees.

Professor ROBERTS. The reason for fixing that point is, that, if you go much above ninety, the danger is that you will get it too hot, and the animal will burn its mouth. It is a safe point.

Secretary SESSIONS. Will the professor tell us the best method of applying barnyard manure?

Professor ROBERTS. I should practice applying it in the fall, on the surface where the plants are growing. Our conditions are different in different places, and we have

to modify our practice accordingly. We are here to direct things. If they do not quite suit us, we change them. In the first place, there are many times in the winter when there is no place to draw manure. There have been times this fall when the ground was damaged and injured more by hauling out the manure than we should have lost by waiting until spring. I do not like to draw manure on Sunday. I do not like to draw manure when there is a great State convention like this going on. There are five months in the year when never a load of manure, except in special circumstances, should be applied. You don't want to apply manure in May, because you are too busy planting. You don't want to apply it in June, because there is no place to put it. You don't want to put it on corn or wheat or oats, and you don't want to put it on your pastures. You don't want to apply it in July, because you are haying and you have no place to put it. You don't want to haul out manure in August, because it is too hot. I take it, you all have some sort of a place in which to store manure for a short time, under special conditions. We began to take out our manure, some two hundred loads, last September, and continued through October and November, and by the last of this month we shall have all our corn ground covered with it.

Now, there are thousands of farmers in this State and in the State of New York this winter who, from the first day of November until the first day of April, are not getting from their cows in the production of milk and butter as much value as the manure. The principal thing for which they are keeping their cows is for the manure. It seems to me there is no other reason. That should be saved, every bit of it. Put it on the land where it will do the most good. If possible, put it on the surface in the fall where there is a plant growing.

Question. Do you recommend putting it on top of the snow during the winter?

Professor Roberts. If the snow is not more than three, four or five inches deep. I will tell you where there is danger of losing it in surface dressing. Once in eighteen years I have seen manure escaping. There was a fall of

rain, and the wind shifted round to the north-west, and the ground was frozen so that it was coated with ice. We spread manure over it. The next spring it began to rain, and of course the washings could not go down into the ground, because of the coating of ice; so they went down hill into the stream. But that is the only time in eighteen years that I have ever experienced any loss.

Mr. STONE. Would you take it out now, and spread it on level land?

Professor ROBERTS. Yes, sir; spread it onto the land.

Mr. STONE. If your land is a side hill, is there any danger of losing it?

Professor ROBERTS. Where you can drive with a span of horses and be safe, there is no danger.

Secretary SESSIONS. I noticed that the professor in his paper stated that he could feed a cow to give thirteen per cent of solids or sixteen per cent of solids, and she would do it. Does he think that by changing the feed he can change the percentage of solids in the milk in any given case?

Professor ROBERTS. There is no doubt whatever of that. Smith & Powell have proved it in a hundred instances. Most of you know that they have established a great reputation for the quantity of milk they produce. They were taken to task because, as it was said, their milk was poor. They went to work to improve its quality, and every attempt they made proved a success not only in changing the solids but increasing the percentage of butter. Cows that would not give three per cent of butter fat were easily transformed into cows that readily gave three and a half or four per cent right along.

Secretary SESSIONS. How did they do it?

Professor ROBERTS. Instead of feeding too rich food in nitrogenous matter and carbonates, they used oats and wheat.

Mr. STONE. Do you understand that fat cows give very poor milk, and that lean cows give rich milk?

Professor ROBERTS. You can improve the quality of the milk very much by feeding. You cannot do it in a short time. A cow has got to work according to the law that is

bred into her. It is just like a boy that has got into bad habits. He gets going in a certain way, and it takes some time to reform him and get him right.

Mr. Stone. I had some experience in feeding a small amount of grain, corn fodder and some grass to a Jersey cow. I got a small quantity of milk, but I could not see but that the cream was just about as thick as if she had been grained more heavily. I am well aware that by increasing the feed we can increase the amount of milk, but the question is, whether we get more cream. I have about made up my mind that increasing the feed increases the amount of milk more than it does the cream.

Professor Roberts. It is more likely to, but you can increase the butter fat.

Mr. Bowker. Where doctors disagree, I do not know what we laymen are going to do. Some of us were at Fitchburg last year, and we remember that Professor Cooke of the experiment station, and Mr. Douglas, whose lecture we all prized very highly (he has now passed to the other side), got into a very animated discussion over this question of heating water for cattle. Mr. Douglas took the ground that water should be heated; Professor Cooke, as our secretary will remember, said he could prove by his experiments and records that his cows gave as much milk when they drank cold water, but were not exposed to the weather, as they did when they drank warm water.

Professor Roberts. What was the temperature of the warm water?

Mr. Bowker. The chill was taken off. So much for that point. I am not here to criticise Professor Roberts; I only want to make these remarks to bring out the point more clearly. You have just stated that we can increase the per cent of solids by the food that we give. Now, am I correct in understanding you to say that you can also change the percentage of the fat and caseine by improving the quality of the food fed?

Professor Roberts. That is not so certain.

Mr. Bowker. I think some of those around me understood you to say that you could increase the fat by feeding a different quality of food.

Professor ROBERTS. There are some experiments which seem to indicate that, but we have not evidence enough to show that we increase the butter fat when we increase the total amount of solids.

Mr. BOWKER. I was afraid that there would be a disagreement upon that point, because I remember being present at a meeting in Connecticut two or three years ago when this question came up, and Professor Johnson said that there was only one record that showed that the quality of the food would change the proportions of caseine and fat. He said that if we wanted butter, we must have a butter cow; that if we wanted cheese, we must have a cheese cow. Is that correct, Mr. Sessions?

Secretary SESSIONS. Perfectly.

Mr. BOWKER. I rose simply to bring out this point, because it is really a nice point, and one which we ought to understand.

Professor ROBERTS. I think you will find some experiments carefully conducted in Germany, which seem to prove, or seem to show (it takes more than one experiment to prove a thing), that where they fed palm-nut meal they did change the amount of butter fat.

Mr. BOWKER. That was the experiment to which Professor Johnson referred. He said that was the only experiment on record, where they fed that palm-nut meal.

Governor HOARD. I am very glad that this question has come up, because I think I can throw a little ray of light upon it. I have been very much perplexed for a number of years with the situation, — the evident teachings of scientific experiments and the evident cross-teachings of certain experiments made by feeders and breeders; but I have been investigating it for a few years, and I have come to the conclusion that, if we would first determine what the percentage of limitation is in the cow, we would then have some guide by which we could determine the possible change of percentage. What I mean by "the percentage of limitation" is this. For instance, we will suppose that the limit in a cow is 4 per cent of fat, 3.5 per cent of caseine, 1.5 per cent of albumen, and 4.70 per cent of milk sugar. We will suppose, I say, that that is her limitation of per-

centage or ratio. Now, I have seen enough to convince me that a cow may have gone all her life, and never have been brought up to that percentage. It lay there, it was born in her, she had it in store, it was latent, but she had never been brought up to her percentage of butter fat; and when she is taken hold of by some feeder or some breeder, and he handles her in this direction, she increases her butter fat at once. He jumps at the conclusion that the feed has done it, when the simple fact is that the cow was doing that which she was constructed to do, but had never had an opportunity of doing.

Mr. Bowker. Right here, governor, would you say that she had not increased her ratio of butter fat, but had increased her percentage of solids, and therefore her percentage of butter fat?

Governor Hoard. The question is, what is the cow's percentage?

Mr. Bowker. Professor Roberts says we can carry a cow up to sixteen per cent of solids, or drop her down to thirteen per cent.

Governor Hoard. He means if she is a sixteen per cent cow.

Mr. Bowker. By nature a sixteen per cent cow?

Governor Hoard. That's it. I tell you, gentlemen, you will never be able to get by the personal equation in the animal, — the individual law of each individual animal. Every man has his personal equation, every cow has her personal equation, and that is one of the reasons why we have stumbled here. These experiments that we have been having have not first determined what was the limit of percentage in the cow. Now, this is the only theory by which you can explain why it is that Princess 2d made forty-six pounds and twelve ounces of butter in seven days. She had a limit of butter fat percentage in her milk that had never been reached. That was the case with other famous cows that have produced these unusual, phenomenal percentages of butter fat, like Landseer's Fancy, like Mary Anne St. Lambert, and like numerous other cows. I believe that is the only theory that will explain it. I have taken a cow and gone along with her and she has given me a per-

centage of four, and under a systematic method of feeding I have seen that percentage rise to five, and in spite of all the feeding I could possibly give her, and every single thing to whet and stimulate her appetite, she never changed it. After it struck five, it remained there. I made up my mind that I had reached the constitutional limit of that cow's percentage. I made some experiments in this line two years ago. We made twelve thousands tests in our creamery. The work we did that summer was enormous in testing the milk of various patrons. We found one patron with two and a half per cent in his milk, and it was honest milk, too. We found another patron with six per cent. We found other patrons with five per cent. We found that, as a rule, the poorest milk could be very much improved, but the best milk was about as good as it ever could be; and we concluded that the intelligent feeders and handlers had brought their cows up to their constitutional limit, but the others had kept them below that place which was theirs by right.

Mr. Bartholomew of Connecticut. If I understand the gentleman last up, an improper ration of feed to a cow does not bring her up to her full richness of milk, but a proper ration would bring her up. Therefore the feed does influence the milk.

Governor Hoard. Yes, sir; improper feed and improper feeding will diminish the constitutional limit of the cow.

Mr. Bartholomew. I think Professor Alvord has expressed the belief that changing the food of a cow does not change the quality of her milk, any more than it would the color of her hair.

Professor Roberts. You say "the quality of her milk;" what do you understand by quality?"

Mr. Bartholomew. The percentage of fat, for instance.

Professor Roberts. There are other solids besides fat. Let us keep to the word "fat."

Mr. Bartholomew. I will say "fat," then.

Secretary Sessions. He did not confine it to the fat, did he?

Mr. Bartholomew. I think it was used in that connection. There may have been other things brought in.

Secretary SESSIONS. As I understood him, the quality of the milk remained the same, but the quantity could be changed by the feed.

Mr. GOLD. I think that in the discussion referred to the scientists and naturalists somewhat qualified the statement that struck the audience as so contrary to their ideas, with this supplementary statement, that you could not improve the quality of the cow's milk by changing the ration, if you had a normal ration to begin with; and when the conditions were normal you could not improve the quality of the milk by feeding a still higher ration. They rather took shelter behind that proposition, which they had not announced to the audience to begin with at all, and the farmers rose up by the dozen when such a statement was made in its bald form. That appears to be about the proposition that they hold to now. We are trying to test this question at the experiment station of the Storrs Agricultural School. We have some cows there, and we have been feeding them several months to ascertain what those cows can do in their normal condition, — how much they will vary when their feed does not vary. We are not ready yet to put them on the test of good feed and poor feed, because we find the cows themselves vary more than we expected they would when we started them on our course of experiment.

Governor HOARD. They will always vary, and the fat will vary.

Professor ROBERTS. I want to ask the gentlemen what we are going to do with that word "normal." That is just like "a big lump of chalk." These men say "a normal ration." What is "a normal ration?"

Mr. GOLD. I do not say that they used that expression exactly, but they used words that in substance implied that idea. We hope to test the relative value of wheat bran, buckwheat bran, turnips, Indian meal, linseed meal and cotton-seed meal in their effect upon these cows. We have been trying to get them in a course of training, but there are a number of difficulties that have come up. They get out of the course of training about as soon as we get them in it. You see that, in order to make the experiments of value, there must be about the same length of time from the

period of calving and also of the anticipatory processes to producing a calf. All those things come in as considerations, and are likely to involve us in error. Then, as our professor in charge studies up these questions, he finds them multiplying on his hands, and he is not so full of faith that he will be able to settle them as he was when we set him at work. But, notwithstanding all these difficulties, we propose to see if we cannot get something out of it that will settle these questions. As dairymen, we do believe that we do not feed our cows so but that by feeding them better we can get not only more milk but get better milk, — get more butter, or more solids, more fat. That is what we believe as dairymen, and we will not object to scientists showing that that is so.

Mr. Ware. We have had the attendance of the Governor of Wisconsin here, and his lectures have been of such a character that I have no doubt this audience feels full of enthusiasm with regard to the dairy. I observe that he is about leaving the hall. Now, friends, let us speed him on his way with three cheers.

[The audience rose and gave three hearty cheers for Governor Hoard.]

Governor Hoard. I am very much obliged to the gentleman, and to the response which has been made to him in these kindly utterances of good-fellowship. I will respond by giving to you the sentiment that an old Irish woman gave me one time, when I had given her a half-dollar. She said: "May the Lord God take a likin' to yez, but not too soon."

Mr. Fitch. I should not rise to speak again, after having occupied several moments of your time, were it not that during the past year I have had from my position perhaps the best opportunity to test these matters in regard to milk of any man in either of the two States of Massachusetts and New Hampshire. It happened in this way. The State Board of Health of Massachusetts were in doubt as to whether they should recommend to the Legislature a lowering of the milk standard from thirteen to some other per cent. The secretary of that Board talked with me about it, and he wanted to know if I had any data. I showed him what I had, and asked him if I might bring him samples at any time, so that he might see them for himself. He said

he would gladly receive them. He said also that he would like to find a farm where the farmer was well enough off so that he could feed what he pleased, and where he would be willing to take the pains in the matter which he desired to have taken. I thought I knew such a farm, and found him one, and he has been making experiments through the year. At the same time the Boston inspector of milk said that if I would send him any samples he would gladly analyze them for me. The contractors have also had from one to three chemists at work all the year, making analyses. Now, the farmers of Massachusetts and New Hampshire are intensely interested in this question, because, if it is possible to bring one cow up to her normal standard, every cow should be brought up. But the question is, what shall I do with my five, six or ten cows? I have heard men dozens of times through the past year say, "We are perfectly willing to feed our cows just as you say; we will do the best we possibly can; we will give them any feed you say, only tell us how we shall bring them up." They had before them on a slip of paper a d zen or twenty analyses of their milk, and it did not come up to thirteen per cent of solids. What was the matter? In some instances I went round and saw what kind of cows they had, and, more than that, the Board of Health required when any milk was sent for analysis that the man should state how long a time had elapsed since the period of calving, what food was used, and a dozen other circumstances. The result has been that it has been shown over and over again that with all the feed, with all the wisdom they can exercise, and everything else that they can do, there are certain herds that cannot be raised to the standard percentage of solids. I have carried samples from the same pail of milk, taken at the same instant, to three chemists, the chemist of the State Board of Health, the Boston inspector of milk, and the contractors' chemist, and have had their three results sent to me, and neither one of them knew that the other had a similar sample. There has been no appreciable difference in their results; and when the feed was changed the amount of solids did not change except in a very slight degree. I take this not from any theory, but from the facts as shown by these analyses.

Professor ROBERTS. How long after the ordinary feed of those dairies was changed to better food were the samples taken?

Mr. FITCH. Sometimes the samples were taken right along, perhaps one a week through the autumn. Sometimes the feed would be changed for a week, and then samples taken; sometimes changed for a day. I do not differ from what the gentleman has said. I do not say there is no change, but I say that I have taken one of my cows and had her milk analyzed by a competent chemist, and the amount of solids one day was 11.169 per cent, and the very next day it was 12.20 per cent with the same feed. That was the change inside of forty-eight hours, but that had nothing to do with the feed. But our standard is a certain amount I do not see how we can bring our cows up to that standard.

Professor ROBERTS. I merely want to say that I should think it would take at least three months of careful, systematic feeding, before you would see any marked change in the solids of the milk of a dairy.

Mr. FITCH. In the case of certain herds that had been fed with corn meal, cotton-seed meal, wheat bran and other such feeds by men that were trying their best to give a balanced ration, the meal was taken almost entirely away, and the amount of solids would come up. Now, that means this, that they had been feeding them in a wrong way; they had been crowding them too much, and when the grain was taken away and they were fed with hay and other things, perhaps ensilage, they were brought nearer to their normal condition.

Mr. PETERSON. It seems to me, Mr. Chairman, that at this, the last stage of this discussion, science has become completely baffled. Although we have learned a great deal in regard to these matters, yet upon this question, where the field of discovery and of knowledge seems to be laid before us, we older ones feel as though we do not know much, after all. Now, will a little bit of experience be of any advantage to the audience? I do not pretend to any scientific knowledge, and all through my experience with cows I have fed for family use, for butter, for milk, and for the health of my family, and I claim that I have had some regard also for the

health of the customers to whom I have sold milk. Recently a village has sprung up on the beach near where I live. These people have come to me for milk, because I can supply it upon two or three or five minutes' notice, and furnish it fresh. That has changed my habits of farming largely, both in raising produce and in raising milk. Well, I found that I was not getting as much milk as I wanted to get. So I said to my foreman, "What shall we do? We cannot afford to sell such a small quantity of milk from these Jersey cows. We want to get more milk, and at the same time we do not want to sell poor milk; and, besides that, there is a law that checks us in that respect." Well, my foreman, who is a Cape Breton man, said, "Suppose we try some gluten and oat meal?" He said, "Down on the island of Cape Breton we use oat meal, and think it is one of the very best feeds." I had been feeding a quart of Indian meal and half a peck of bran to my cows; that was their regular ration. I then began to feed the gluten meal and the ground oats, and all at once there was a wonderful increase in the amount of the milk, but it began to grow thin. Whether it was as healthy or not, I cannot say, but there was a greater quantity. That was a lawful feed, you will see; there was nothing to be said against it in the way of fraud or imposition on the public. I had two cows that were fed on the meal and the bran that were showing signs of garget, a thickening of the milk. What should I do? I increased the ration of gluten meal and ground oats, and it corrected that habit at once in those cows. But what is the normal condition of a cow? I have hardly been able to ascertain that, and I hardly know what "limitation" means in that connection; but I know that each individual cow, like each individual human being, has a certain bias, and that it should be studied and recorded. I know, too, that a uniform practice or system cannot be adopted. That brings us back to the individual, instead of to the mass. We want to study the character of each individual cow, as we would the character of each individual boy or girl.

Mr. Bowker. I want to keep this discussion, if I can, upon a high level; and we have here a man who is just as full of meat as a nut, and we want to use him. I know this,

because I have followed his work for the last twenty years. He spoke about the application of manure to the surface all through the winter if we could get it there, and he said there was but little loss. Now, I wish he would explain to us why there is comparatively little loss. I wish he would explain the nitrification that is going on in the soil, which transforms the organic matter of the manure into nitrates which are taken up by plants. If he will explain that to the audience, he will illustrate this matter of the application of manure.

Professor ROBERTS. In the first place, when green manure, as we term it, is taken from the stable and spread on the surface of the ground, comparatively little of the plant food in it is soluble. We place it on the soil, and immediately or very soon water is present. It leaches into the soil, and the moment it can come in contact with the earth or with a plant, it loses itself there. That is nature's law. You may take urine and pour it through moderately coarse sand, and what leaches out, if you pour it slowly, will be fairly clear water. Now, the plant on the land grows in the winter. Do not forget that. If you do not believe it, take a section of a clover field, manure it now and rake off the manure before spring comes, and see if the roots there are not more numerous and if the plant is not ready to begin its summer work better than when no manure is spread. The soil has a great affinity for all this plant food, and so you cannot get it on the ground without its going into the ground; and that is why I object to that abominable open barnyard. It is the ruin of farmers. The average barnyard in our county in New York contains a quarter of an acre; that is, about one hundred by one hundred and ten feet. In the State of New York thirty-two hundred tons of water fall annually on an acre, so that eight hundred tons fall on that quarter of an acre. You cannot get round it; that is the law. Now, is that eight hundred tons of water carried out with the manure at the end of a pitchfork annually? If so, can you afford it? Secondly, has not the manure that is left there somehow been leached? Many a farmer tells me that the bottom of his barnyard is tight, his manure does not leach, and then I say, "What becomes of the water?"

Mr. BOWKER. Some of it evaporates.

Professor ROBERTS. Yes, some of it evaporates. That is right. I tested a small barnyard fixed on purpose, and found that every ton of water that leached out carried with it sixty cents worth of plant food. Now, one purpose in spreading manure in the fall is to form a blanket or covering for the plant. That is nature's method. Another thing is that to-day, on the average farm, except in special cases, there should not be an acre nor a rod of land without a plant growing on it. That may be new to you. Every inch of open land is sowed to rye on our farm, no matter what we want it for, and the next spring it is ploughed under or it is grassed over. Wherever nature cannot grow plants, she cannot make a soil; that is wilderness. Before my corn is cut, there is a man with a horse sowing rye in the corn field, a bushel or two bushels to the acre, just according to the size of the pocket-book; but two bushels are better than one, because we get more plants.

Now, the next thing that has been found by recent experiments, and it seems to be established beyond a doubt, — I think we cannot gainsay it any longer, — is that microbes, low forms of life, are in the soil, and have their homes in dead and living vegetable matter; that they multiply with very great rapidity, and are able to absorb the nitrogen of the air and combine it with the nitrogen of the soil. You know that four-fifths of the air is nitrogen, and by properly cultivating these microbes, if you please, by stirring the soil frequently, what we term nitrification will go on; which simply means that we are cultivating microbes, making them grow. We can increase, from ten to twenty per cent, the nitrogen in the soil, without putting any nitrogen upon it.

Now, my experience is this, — that the more farm manure I save the better, and the more farm manure I have the more commercial fertilizers I want; but commercial fertilizers should not be used in connection with farm manure on the general farm, but concentrated on gardening, where I believe we shall come to use almost exclusively commercial manures. My notion is, that the wheat farmer, the grass farmer or the dairyman, will only use a commercial fertilizer when he sees that there is such a lack of a certain

element of plant food in a particular field that he can make no money out of it. The roots in an acre of good clover analyze with us about eighteen dollars' worth of nitrogen, potash and phosphoric acid, or more than enough plant food to raise twenty-five bushels of wheat to the acre.

There is a big question here in regard to furnishing fertilizers to the soil most economically, and getting the nitrogen, potash and phosphoric acid out of the soil. They are no good in the soil unless somehow you can coax them out and start them through a plant, then through an animal, and as they go round the circle reach in and take out the little fraction which you want to live on. And there are some very strange things connected with the question what we shall raise to sell. Now, if I raise wheat and sell it at eighty cents a bushel, when I get two hundred dollars in my pocket I have sold sixty-seven dollars' worth of my farm at eighty cents a bushel. If I ride a twelve hundred pound horse into Boston, a half-blood Percheron draft-horse, I will say, and get two hundred dollars for that horse, I have sold seven dollars worth of my farm. If I take into Boston two hundred dollars worth of butter, at twenty-five cents a pound, I have sold about sixteen cents worth of my farm. I can buy it at the drug store, put it in my vest pocket and carry it home. So that in what we shall take toll from the soil becomes a great question in agriculture.

Mr. Eaton. Where farmers use liberally of stable manure, is there any necessity for their purchasing commercial fertilizers other than phosphoric acid and potash?

Professor Roberts. I do not think there is, if first-class culture goes with it. It must be first class. I go back again to Nature's method. For ages she ground and pulverized, by water, by frost, by every known force which Almighty God could bring to bear, to make the soil fine, and where she did not get it fine she did not get soil, she got rocks. Let us go and do likewise, use a little more skill, and see if we cannot get the soil a little finer; then sow our plants and feed them liberally, and after the plants are grown feed them to the animal; and then the animal, which has only utilized a little fraction to supply its wants, will give the balance back to man for his use, if he will not

waste it. There is the whole trouble, — in the waste, not in the little butter and meat and corn that we want for ourselves. The rest is all to be carried back finally, every bit of it, and so there should be no loss.

Now, I do think, gentlemen, that, if there is anything that is needed in the United States above all other things, it is a reformation in regard to the care and preservation of farm manures. Some six or seven years ago I sampled every load of manure that went out of our covered barnyard. I found that we had produced in our barnyard upwards of sixteen hundred dollars' worth of potash, phosphoric acid and nitrogen, computed at the ordinary prices. Well, this so astounded me that I dared not publish it; and so the next winter I took particular pains to count all the animals, to estimate very carefully the amount of food they consumed, and to sample again and weigh every load of manure that went out of the covered barnyard; and lo and behold, I found the results of the winter before verified. There were about forty-five head of cattle, some eighteen or twenty horses, and so on. And don't forget this, if you forget all the rest, that, with an ordinary ration and an ordinary animal, with ordinary prices, the manure produced by an animal is worth half of the cost of the food fed to it. Can any man afford to waste such a large percentage as one-half of the cost of the food? That is what it amounts to. Now, if I went to your barn and saw the wheat running out of your granary through a rat hole, would you ask me, "My dear professor, would you stop that rat hole with an oak pin or a hemlock pin, or don't you think an iron bolt would be better to stop that rat hole?" You would not do any such thing; you would run and get the first thing that you could lay your hand on, and plug that hole. If it was not anything more than your wife's last year's sun-bonnet, that hole would have to be plugged. Therefore I need not say a word about the details of saving manure. I know that you have good sense, and I know that every drop of solid and liquid manure is under your control as perfectly as the wheat in the field.

Mr. Bowker. Would you compost in the field, or in the barn?

Professor ROBERTS. I would not compost; I would get it from the stable to the field and to the plant the first opportunity.

Mr. BOWKER. If you were a market gardener?

Professor ROBERTS. I cannot speak of market gardening; I know nothing about the business.

Mr. SHAW. I would like to ask if clover sown at the second hilling of corn or a little later will attain sufficient growth to be of any benefit to the next crop?

Professor ROBERTS. Yes, sir; it will be of some benefit, but it is pretty expensive seed, you know, and the clover plant does not do its best until it is about a year old, and you would only get about five, six or seven months. The soil seems to be much richer in nitrogen after a clover crop. That is the work of the microbes, the living organisms in the soil. I thought I made that clear, — that recent discoveries have proved beyond a doubt that even without clover, if we have vegetable matter in the soil, by careful culture in hot weather we may add materially to the nitrogen in the soil.

Mr. J. H. HALE of Connecticut. I am particularly interested in this subject, and have been greatly interested in what Professor Roberts has said. I have always had to study the question of fertilizers; it is a matter of life and death with me and with a good many New England farmers. In my observations when visiting other farms and learning what I could about agricultural and horticultural matters, I have never found an unsuccessful farmer who practices Professor Robert's method of hauling out manure in the fall or in the winter, or at any time except mid-summer, and spreading right on the field. Wherever I have found a man doing that, I have found a successful farmer every time. This is the practical side of the question which has always interested me.

Now, as to the matter of commercial fertilizers and the purchase of nitrogen. Our farm is a small one, but we need to cultivate pretty thoroughly, and, as the professor says, we are continually stirring the soil. We keep the horse harrows moving all the time from early spring until late fall, and while we have bought a great deal of manure and

thousands of dollars' worth of commercial fertilizers in the last fifteen years, we have found that we have been able to grow crops at a profit, and that our land has improved in fertility every year. The productive capacity of the farm has doubled over and over again in the last fifteen years. We have bought only potash and phosphoric acid. We have never bought nitrogen except what little we have got in fine-ground bone, buying simply those two cheap elements of plant food, and but very little of the high-priced nitrogen, trusting to luck, perhaps, to get it in some other way, or trusting to cultivation.

Professor ROBERTS. Trusting to the microbe.

Mr. HALE. We did not know it was the microbe, but if that was the fellow we have trusted to him. I am satisfied that, by thorough cultivation, and, as the professor says, never letting the ground lie bare, but when one crop is off have something else growing there, and simply purchasing potash and phosphoric acid, you can not only grow crops at a profit, but you can build up the worn-out New England farms. If there are any such they are simply mismanaged, I should say.

The CHAIRMAN. Two years ago a man who keeps one of our first-class restaurants called me into his store and said he wanted to show me some peaches. He said, "Why is it you Worcester fellows cannot raise peaches like these?" I did not tell him we did not know how to do it. He said, "These peaches came from Mr. Hale in Connecticut." This is the man who two years ago raised about fifteen thousand baskets of peaches. I speak of it to show you that his remarks are backed up by results. He is known all through the East and even in New York State as the most successful peach grower that we have in New England.

Mr. WEST. From what material do you obtain your phosphoric acid?

Mr. HALE Finely ground raw bone.

Mr. PETERSON. It would be profitable to us if we could raise peaches as Mr. Hale does. Can he throw any light upon this difficult question of peach growing without taking up too much time?

Secretary SESSIONS. He has given you a little light on

it. He has told you that he keeps his cultivators going from early in the spring until late in the fall.

Mr. Rice of Worcester. There is quite a controversy in regard to clean culture and having crops in an orchard. I would like to have Mr. Hale's idea in regard to clean culture for orchards.

Mr. Hale. Keep the horse cultivator in there. That is the only crop I would let in.

Professor Roberts. When the orchard gets large, put in a flock of sheep and manure it in that way. If you have an orchard that would pasture a hundred sheep, put in two hundred and fifty, and then give them enough grain to supply the deficiency of grass. Every apple that falls will be eaten, and the ground will be richly manured.

Mr. Rice. Should you object to keeping an orchard entirely uncultured all the time, and have nothing grow on the ground except the trees?

Professor Roberts. No, I would not, after your trees get large. I think you can accomplish the result quite as easily by feeding sheep in your orchard, and make a good round sum from the sheep, and also make quite as much from the apples as you would if you cultivated it. Swine in an orchard are not nearly as good as sheep.

Mr. Gold. Mr. Hale's remarks in regard to culture referred to peach trees.

Mr. Bowker. I do not want to have this discussion digress into a talk about commercial fertilizers, but I do want to say a word with reference to this matter; for my friend Mr. Hale raises fruit, and, as Professor Roberts will tell you, fruit is made up largely of sugar and water, very little nitrogen enters into it. But, if the professor were raising a crop of cabbages, would he depend entirely upon the air for the nitrogen, or on the microbe in the soil? Or, if he were raising a crop of tobacco, one of the largest feeders that we have, or a crop of potatoes, would he depend upon that little fellow in the soil to develop the nitrogen that he wanted, especially when the potato grows, as we know, in thirty or sixty days? You see, we must consider just what we are growing. One man grows wheat out in New York State, where clover is not worth much to feed,

and another man grows it in Massachusetts, where clover is worth something; and one man raises fruit down in Connecticut, where the air and the sunshine give him a large part of the material which he wants, and another man, my friend Rawson, for instance, raises early cabbages out in Arlington, and he wants to get his crop in the market just as quickly as he can. Now, these are conditions, and not a theory.

Professor ROBERTS. I do not think I can answer all those questions in a specific way. I should say that I would prefer to take for illustration the corn plant.

Mr. BOWKER. Now, professor, that is hardly fair, because the corn crop is not a great feeder on nitrogen. Well, go ahead.

Professor ROBERTS. In the corn crop we want an early, rapid growth. Nitrogen is largely used in the early stages of growth. So, if you want to push a corn crop, push it with nitrogen; but, if you get too much nitrogen in the soil, the plants will be weak and watery.' I can spoil a root crop with a heavy dose of raw manure produced from feeding rich food. So I would put my commercial fertilizers on my roots, I would put my nitrogenous manure on the grasses and on the corn crop, but I would be careful not to get too much of it on the corn, because I shall want phosphoric acid to mature the kernel.

Mr. GERRISH, of the "Mirror and Farmer," New Hampshire. I want to say just a word on this nitrogen question. I want you to understand that I am a practical working farmer; I work my pencil as a little side issue, using it from a practical farmer's stand-point. Nearly fifteen years ago, when Professor Sanborn was on our college farm, he wanted me to take part in a series of experiments on corn, and wanted me to furnish the chemicals. I sat down and wrote him, "Professor Sanborn, I have always raised sheep and clover on my farm, and I cannot afford to buy nitrogen to raise corn; but, as a matter of experiment, I will buy it in order to be uniform with the experiments in other towns." Pretty soon Professor Sanborn and the scientists got my idea, and Professor Sanborn came out and those gentlemen came out and Lawes and Gilbert of Eng-

land came out, and I have got them all on my side, that we cannot afford to buy nitrogen to raise corn. I have never had a chance to claim the credit of that until now. I have practiced applying my manure in the fall. I have eighty loads in the cellar now, which will be drawn out and put upon the ground as soon as it can be. I have done it for years, but I have not a neighbor or a townsman who has dared to do it.

Mr. Ware. We have passed a vote of thanks to every speaker, and certainly if any of them are worthy of it, Professor Roberts is. I move a vote of thanks to him for his able and instructive lecture.

The motion was seconded, and carried unanimously.

Adjourned to 7.30.

### Evening Session.

The meeting was opened at the hour appointed, by the singing of a duet by Mr. George C. Rice of Worcester and Mrs. G. A. Wason of New Hampshire, which was loudly applauded.

The chairman then introduced as the lecturer of the evening Hon. John E. Russell of Leicester, late secretary of the Board.

## THE AGRICULTURE OF THE NILE VALLEY.

BY JOHN E. RUSSELL OF LEICESTER.

The Nile is, in ancient speech, the parent of Egypt. The inhabited country is the actual bed of the river, bounded by the rising lands and mountain chains of the Lybian and Arabian deserts upon each side.

The remarkable physical fact is that rain practically does not fall in this region, and all vegetation is confined to the land that in the annual rise of the river is overflowed by it, or that is watered by irrigation. Much of the ground is several months under water, nearly all of it is not only watered, but also fertilized by the black silt or slime, as it is called, and which it resembles, that is brought down by the flood; this comes in great part from the last tributary

of the Nile, the Atbara, which enters it in lat. 17° 45′ N., taking its waters from the Samen Mountains.

The annual overflow of the Nile is one of the greatest marvels in the physical geography of the globe; with the regularity of the re-appearance of the stars in their orbits its movement may be expected, only retarded in hours or minutes by adverse winds that slacken its current, rising to within a few inches of the same height each year, and remaining full about the same time; this is recorded as having taken place with almost unbroken regularity, for nearly ten thousand years. There is evidence that there have been failures and consequent famine; from what cause is unexplained.

The rise is due to the prodigious rains that, in their regular season, fall in the equatorial regions; the river begins to swell about the 25th of June, and goes on with gentle rise for three months, when it reaches its full volume. It remains at flood twelve days, then subsides with the same gradual and gentle action. The rise is about forty feet at the tropic of Capricorn. At Thebes it is thirty-six feet, flooding the Temples of Karnac on the other side of the river, and rising to the knees of the vocal Memnon. In ancient days these great works were protected with dykes. At Cairo and the vicinity of the pyramids the rise is from twenty-five to twenty-seven feet. Great effort has been made from the earliest times to fill canals and artificial basins with the water, and retain it for the subsequent irrigation of lands distant from the river; these works exist in all parts of the country where there is any considerable breadth to the valley, and it is a large part of the business of government to maintain them.

The first sight of the full Nile is at Cairo. Here it is a powerful stream, about five-eighths of a mile wide, flowing with strong current between high banks, and crossed by a fine suspension bridge. The great city of Cairo is chiefly on the right bank, but it extends to the other side, and the pyramids, though five or six miles away, seem to rise above the sycamore and acacia groves not half a mile from the bank.

The Nile is peculiar in various aspects. It differs from all

other streams in the character and in the beneficent effect of its annual flood. It is remarkable in the fact that its valley was the seat of a civilization thousands of years before even our conjecture, and that from it proceeded the knowledge that established Greece, and also in the physical wonder that for fifteen hundred miles it flows through a desert without receiving a tributary, wasted by the unclouded sun, the thirsty soil and the drafts upon it, for irrigation to supply the needs of several millions of people. This continuous waste has the effect peculiar to this river, that it grows larger as it is ascended, until, a thousand miles to the south, its mighty torrent pours through the sculptured walls of its rocky sides, in volume and power far greater than that which passes Cairo, and divides into the two branches that make the Delta and join the Mediterranean. The river at Cairo is alive with craft; all the business of upper and middle Egypt comes down in large boats with the vast triangular sails called lateen, so much used in the Levant. There are small mail and government dispatch steamers, and large steamboats that ply with passengers as far as the first cataract, which is about six hundred miles.

The travelers' observation of the Nile valley, except what he gets from his railway journey from Cairo to Alexandria, or across the land of Goshen to the Suez Canal, must be from the journey up the Nile; and the only way to properly make this voyage is to take a Nile boat and spend the winter on the river, slowly sailing up with the north winds when they favor, and sailing with the south winds and drifting back again with the current, in the spring. To do this I chartered the boat "India," one hundred and ten feet long, drawing thirty-four inches; two masts, one at stern and one at bow, carrying large sails. The cabin occupied about two-thirds of the boat, and the top of it made an upper deck with awnings and seats. The crew consisted of a captain, steersman and fourteen men, a cook and assistant, two cabin servants, and the dragoman, who is the glory of the East, the guide, philosopher and friend, interpreter, caterer and never-failing comforter of the traveler. Our dragoman was a good Mussulman, bearing the honored name of Hassan Mahomet; an Arab of ancient lineage and gay apparel. His dress was

Oriental, except that he preferred European shoes to the slipper of his people that can readily be thrust off at the door of the mosque; his full petticoat trousers, gathered at the ankle, were of the finest cloth; his jacket of the same color, — usually a fine blue, — and tastefully embroidered with black on the seams; a silk vest of yellow or scarlet to the throat; about the waist a rich Persian scarf, a heavy turban in which was wound a Damascus handkerchief of such beauty that whenever I looked at it I was reminded of the famous handkerchief that Othello describes: "That handkerchief did an Egyptian to my mother give; there's magic in the web of it. A sybil that had numbered in the world the sun to make two hundred compasses in her prophetic fancy sewed the work, — the worms were hallow'd that did breed the silk, and it was dyed in mummy that the skillful conserved of maiden's hearts."

This man's accomplishments were various; he was skilled in languages, his good nature was unfailing; he had abundant tact and patience; he was a thorough servant, waiting at table, and always ready to accompany us on shore for excursions, of which he arranged every detail, and intending that nothing should ever disturb the comfort or ease of his travelers.

With this outfit, one lovely December afternoon, a north wind blowing in from the sea, our captain, a gloomy and dignified Egyptian, carried an anchor out toward the middle of the river from the Cairo bank; our vessel was then pulled to it, and, hoisting our great lateen-sails, we soon saw the citadel and minarets of Cairo behind us, on the left, and the pyramids, dark against the glow of the evening sky, on the right. At night-fall we tied to the bank at Memphis, within easy reach of some of the most interesting monuments in the world.

It is not my intention, this evening, to attempt any description of the temples or tombs of Egypt. Egyptology is, in our day, a science that has created libraries, and absorbed the whole attention of many devoted students. It was my good fortune and intention to meet two of the most eminent of these gentlemen, the renowned German author, Brugsch Bey, in charge of all Egyptian antiquities, and the

celebrated English authority, Professor Sayce. I had also the pleasure and profit to travel nearly all the distance up the river in company with the boat of Mr. Charles Wilbour of Paris, a distinguished Egyptian scholar, who, with the American artist Blashfield, had a boat about the size and equipment of ours. From these gentlemen I had much advice, assistance and information. My purpose before this assembly is to treat in a cursory manner of the agriculture of a rainless climate, with a few observations on its limited botany.

The continent of Africa, east of the Barbary States, bordering on the Mediterranean Sea for a thousand miles, and extending south for nearly two thousand miles, is a mighty expanse of rainless desert. Groups of mountains and chains of rocky promontories add to the lonely desolation of these wastes. The atmosphere is brilliant, and the winter air cool and bracing, but the eye seeks almost in vain for vegetation; there are, at wide intervals, oases where water is found in wells, and there are marshes and bitter lakes, but they are like little islands in a wide ocean. This terrible monotony is broken by the Nile, and the prodigious fertility of the narrow strip of land subject to its overflow.

In such a country the perennial flora must be one that in a state of nature withstands the months of inundation when the valley is soaked with water, and that can absorb moisture and store up strength enough to bear the complete drouth of the intervening season. There is no forest, and all plants that in tropical regions flourish in dim shade and upon the moisture of dying wood, and all the parasitic life of vine and air plants, are here unknown. The seeds of the North, carried by winds or birds, obtain here no lodgment. The slime of the Nile or the parched earth destroys them. The small number of plants that remain may be recalled without a written list. The date and doom palms, the acacia, the tamarisk and the sycamore fig are the chief of these, and live the better the nearer they are to the river bank. With irrigation, orange, lemon, pomegranate, apricot, almond, myrtle, jasmine, rose and similar vegetation flourishes.

Useful annuals seem to depend entirely upon the care of

man; all of them are probably exotic, but they grow with a vigor and yield an abundance such as no other part of the earth can excel. Rice, sugar-cane, sorghum, cotton, castor-beans, indigo, wheat, barley, peas, beans, onions, cucumbers, melons, tomatoes, etc., are the annual crops. Weeds are practically unknown. The seeds that germinate are only those that are put in at the right time with a purpose. Manure is not used, though it would be effectual in increasing the crop. The vast mounds of ruined cities give a nitrous earth which increases the yield of grain; but there are no carts or wagons to draw it, and, as the average crop is about forty-five bushels, it is about all that can be expected even from Egypt.

In a country without forest there must be some provision for fuel, and animal manure is kneaded in water and dried in cakes, and is merchantable fuel for cooking. Lamps fed with castor oil are also used, and sorghum stalks are a useful fuel.

The time for planting is on the retirement of the water in November. I had supposed, from the Scripture text of casting bread upon the waters, that the seed was sown in that way; but it is not. The ground is allowed to dry, and then broken with the plough, drawn by oxen or by a single camel. I have seen an ox and camel in uneven yoke ploughing together. The plough is commonly the wooden model used in the time of Moses, or a few thousand years before Moses. Some advanced plantations have good English ploughs. With the assistance of my dragoman, I told a farmer of the light and effective American plough. He asked how many crops we raised in the year. I confessed to but one. He replied that he had two crops. He then inquired how much wheat would be had from his field of about two acres, in my country. I told him, with some exaggeration, that it might be forty bushels. He gravely stated that he would have at least ninety, and would follow that crop with cotton, of which he would make half a ton. The wheat straw would feed his camel, buffalo cow and two asses during the inundation, with some help from sorghum stalks. He said under the circumstances he thought his crooked tamarisk-root plough was better than mine; and

added that God was great, and kept many things unrevealed, to which I assented.

I asked him about his taxes. He differed from the American farmer, in that he knew what they were, and when they hit him. He paid tax when he bought salt, in its increased price, and on tobacco, if he used it; for the rest, his land being of the best, and well situated for overflow and irrigation, he was rated at the top, and paid twelve dollars an acre in money. He complained bitterly of the tax; I told him that God was great, and there was much that was not revealed; but, humanly speaking, in view of the productiveness of his land, his tax was not high. The only trouble he had was in not owning more land. He asked me about the taxes in my country. I told him that the taxes in my country were upon spirits and tobacco, and what was not produced by that tax was so arranged as to fall upon farmers and laborers. I did not add that the government of my country also gave the right to tax farmers and laborers, to a small body of individuals and corporations, under the pretence of enabling them to pay extra wages to some three per cent of the population, and left it in their hands to carry out the agreement, because I was not anxious for his comments on such political economy, and did not wish to disturb his opinion that I belonged to a superior race.

The Egyptian does good work with his wooden instrument, the "sacred plough," which in ages long ago employed "the kings and awful fathers of mankind;" it breaks up the black soil, he harrows it with a spiked roller or a V harrow of primitive pattern, and broadcasts his grain, grass or clover. Beans he puts in hills or drills, according to his fancy. Peas, lentils, vetches, etc., seem to be scattered in patches. Onions are carefully planted in beds, and yield enormously the finest of their kinds; other vegetables grow in abundance and with great delicacy of flavor; in eating them one cannot help sympathizing with the Israelites of the wilderness, who mourned for the flesh-pots of Egypt, and sighed for the good living of bondage. "We remember the fish that we did eat in Egypt, the cucumbers and the melons, the leeks and the onions and the garlic."

The first tax the farmer has to meet is the swarms of

birds. The valley of the Nile is the winter aviary of the North; it is a bird thoroughfare. The aquatic birds are seen in great variety and in enormous numbers. The gray goose flies in V-shaped flocks like clouds; the "ruddy goose," with cranes, pelicans, storks and ducks, haunt the shallows; while on land, quail, plover of several varieties, and flocks of pigeons with small birds, settle upon the seeded ground; the farmers allow a quarter of all small seeds to the birds. Boys armed with slings stand upon the towers built in the fields, and, with the dexterity of young Davids, throw balls of hard-baked mud continually to keep the birds on the wing. Here the sportsman is welcomed, and, as the birds rise from the slingers' attacks, he knocks down pigeons by the dozen.

But the great and never-ceasing toil of the Egyptian farmer is in irrigation. With the subsidence of the river, the crop of whatever kind requires water; the dews are copious and refreshing, but, to get a full crop, water must be supplied to even wheat and clover; this is done by raising it from the Nile in three ways. On large plantations, and at the great gardens of the wealthy, steam engines are used to pump it into channels, from which it is turned when needed; but the older method of a well in the river bank, in which a ten to twelve foot wheel with an endless chain of buckets is turned by a vertical wheel moved by oxen is the common way; this is called a "Sakia." Smaller farmers use the "Shadoof;" two slender posts, thirty inches apart, with a top cross-piece over which a sweep, with a large, wide bucket or basket, lined with cloth or leather, is worked by a man, who with great speed and dexterity dips water, pouring it into a channel by which it is conveyed to the crop. His bucket is balanced by a weight made of a lump of sun-baked mud. This simple machine will raise water about eight feet; when the bank is high, two and three may be used, one above the other.

The river from the second cataract, a distance of one thousand miles, is lined on both sides with this work,— sometimes they are not more than two or three rods apart for miles; many are kept at work in moonlight nights. They are not greased, and give a wailing, groaning sound,

as if the labor were a pain; and the men chant a sad strain in a minor key, unchanging in character, never ceasing from early dawn to dark.

When wheat and clover or beans are off, the ground is ploughed and seeded at once with dourra, a sorghum raised for seed and fodder. This is the grain for animals and for the bread of the poor; or cotton may be planted. This is irrigated, and is perfected during the inundation. The date palm is a certain source of revenue. A grove of palms is a valuable property. Like all the palm family, it is a beautiful feature in the landscape, though far inferior in this respect to the glory of the cocoa palm of the East Indies and the American tropics.

The animals of Egypt that assist the labors of the farmer are the patient and laborious camel, who bears the heavy burdens, and makes long journeys sustained by the most slender fare. I could not learn that either the flesh or milk of this coarse animal was part of the diet. The horse is not common, though I saw fine specimens belonging to the Bedouins; but his cousin, the ass, is in great numbers, and useful to an unexpected extent. They ride them without saddle or bridle, guiding them with a stick or sorghum stalk, or by cuffing them with the hand. Docile, patient, industrious and frugal, the ass is the friend and companion of the poor Egyptian. The buffalo of the East Indies was introduced into Egypt at a very early period, and is an ugly but useful servant; the cows are large milkers, and the milk is rich. There is a native breed of cattle much resembling the Jersey in size, shape and color. They are poor milkers, but good workers, and are used greatly in working "sakias." Sheep are largely kept, and are nearly all of a rich, reddish-brown color; the wool is about the quality of Southdown, the mutton excellent, and the lambs large and fine. They are kept in small flocks, and, when fed upon growing clover, are each tethered to a peg, and made to eat the ground clean as a floor. I bought sheep occasionally as a gift to the sailors, and found a good sheep cost about the same price on the Nile as in Massachusetts. I saw some of the fat-tailed Syrian sheep, and crosses of them. They are not large, but have an enormous development of tail, which

is clear fat. This fat is soft, and is used as butter by the lovers of pure, soft mutton tallow.

The gallinaceous fowls are abundant; what we call barn-yard fowls are of a very ancient race, small, hardy, great layers of small eggs. The American turkey is domesticated, and as fine as those raised in Rhode Island. Ducks and geese are plenty.

We bought milk and cream on shore every morning, but did not indulge in the native butter. And here let me say, in digression, that our cabin was supplied with excellent butter, made in Lombardy and sent out from Milan; it was put up in one-pound tin cans. This Italian butter was of admirable quality, and perfectly uniform.

One of the important industries of Egypt is the artificial hatching of eggs. Over ten millions of chickens are thus produced. This industry is of great antiquity, and is described in many old publications. I had no opportunity to observe the process, so I will not attempt to describe it.

There are no roads and no wagons in Egypt, except in the large towns like Alexandria and Cairo, where the wealthy and the strangers ride in carriages. The Nile is the highway of Egypt; it is the thoroughfare of the country, the main street of every town. People swim across to go visiting on the other bank; ferries of small and large boats, crowded with people, goods, produce, asses and camels, are always running. There is no loneliness on the banks; the six or seven million children of the river live within sight and daily touch of its life-giving waters. Often I listened to the mighty noise of bawling, hallooing, talking, laughing, the growling of camels, braying of asses, crowing of cocks, the wailing of the ungreased wooden wheels of the endless sakias raising water, and felt, with the ancient observer, that "Nilus heareth strange voices." Our boatmen were eternally singing; they had rude instruments of music, such as are used in upper Nubia; and at night they sat in a circle and sang strange Arabic songs in the minor key to the throb of a drum beaten with the hand, and a tinkle of brass rods struck together.

The taxes of Egypt are excessive, owing to the extravagance of the rulers in living, in building palaces and public

works, railroads, irrigating canals, telegraphs, etc., in advance of the necessity of the country. Great loss was incurred in the construction of the Suez Canal. The government became bankrupt about ten years ago, and England took charge of the country in the interest of the bondholders of the debt. The revenues of the country amount to about forty-eight millions, of which twenty-six millions are derived from a direct tax on land. A country so poor as Egypt can derive but little money from customs duties, which we well know fall not upon property, but upon consumption A people who go nearly naked, who sleep on the ground, and have no furniture in their huts, cannot easily be reached by indirect taxation. Salt and tobacco must be had by the poorest, and from these sources several millions are derived. A country without forests, mines or water power must be agricultural; and, though cotton is a very large and increasing crop, the only manufacturing that has ever been done in Egypt on a large scale is in the producing and refining of sugar.

The amount of arable land is about one-half of that in Ireland; but its productiveness ranks it far above that of Ireland. The agriculture of Egypt has been carried on in much the same way, and apparently without the least exhaustion of the fertility of the soil, for thousands of years.

The date of Mena, the founder of the city of Memphis, is now put by Egyptologists at about seven thousand years ago. The pyramids date back more than six thousand years. These and contemporary works indicate a civilization in which society was regulated by firm laws; a religion founded upon high morality; a perfected language and advanced literature; a knowledge of mechanics, engineering, chemistry, metallurgy; a people clothed in fine fabrics of linen. This development of social life carries mankind in this valley back to an age of the world misty in point of time; and, as agriculture was their means of living, we may well conclude that this narrow strip on each side of the Nile has been annually cropped for more than ten thousand years, — perhaps double that time. We know, from the innumerable representations in sculpture and color, depicting the ancient life of Egypt upon the walls of tombs, their methods

of living for about seven thousand years. Indeed, we know more about the life of ancient Egypt than of the lives of our British ancestors five hundred years ago, or than we know of the common affairs in Plymouth Colony in the first century of its settlement. We know about their government, religion, domestic and political economy; how they lived, loved, sported, worshipped and died. We not only have the monumental effigies of their kings, but we have many of their actual bodies in our museums; and the traveler, or "Cook's tourist," who visits the Boulac Museum at Cairo, may look in the face of the great Sesostris himself, who ruled the civilized world before Moses was born. We know how these mighty men went to war, the weapons with which they fought, the chariots in which they rode; the people they conquered, and how those people looked and dressed. We know how the ruler of the land received embassies, and how the embassadors looked and acted; what tributaries came with them from their wars, gracing with captive bands their triumphs; we see the gifts they brought, and the spoils of war. We know that the gay and rich gave great entertainments, and that even ladies at times drank wine until the lotus flowers drooped in their hot hands. But the history of Egypt, unlike the conventional history of other people, is not confined to the doings of the great. We see how the common people lived; how they ploughed, sowed, reaped, fished, fowled; how they gathered fruits, made wine or strung onions. In the tombs at Thebes there is scarcely an occupation of human life that is not delineated on the walls; and all indicates a busy, thrifty life and a superior morality, the reign of law and the equality of woman.

At Beni Hassan, in the mountains, but a few days by boat from Cairo, there is a wonderful delineation of the life of Egypt, in spirited colored drawings, on the walls of beautiful tombs cut in the rock. These scenes delineate the lives of some distinguished people who were the hereditary governors of the province more than twenty-five hundred years before Christ. These pictures are fully described in Dr. Brugsch's works, and are largely copied in the illustrations of the works of Sir Gardner Wilkinson. They describe

many agricultural occupations, among them the culture of flax and manufacture of linen; fishing and catching wild fowl in nets. Ladies are represented entertaining company and playing the harp. These tombs are dated, and have many inscriptions. In the epitaph of one of the rulers he is made to say: "The hungry did not exist in my time even when there were years of scarcity; I ploughed all the fields and found food for the people, and I gave them what it produced; I gave equally to the widow, as to her who had a husband. I did not prefer the great to the humble. He who sowed was master of his crop, and I kept back nothing for myself from the produce of the lands."

This was good morality in the year 2500 before Christ, and would be now. It was some centuries after these tombs were made that we have the Bible record of Joseph and his brethren going from the arid plains of Palestine in time of scarcity to buy corn in the rich valley of the Nile. The seasons of scarcity in Egypt must have been caused by incomplete inundations of the valley, and are referred to as possible though of very rare occurrence.

The present race of Egyptians has the characteristics of the people whose forms and faces are sculptured and painted on the walls of temples and tombs, though crossed with the Arabian conquerer and then by the Turk. The purer and more ancient blood will always tell in a crossing of races, and this is noticeable in the frequent occurrence of the Egyptian type. They are a handsome race, with fine, oval faces and tawny complexion, rather of a bronze color; their hair is straight and black, eyes bright, straight noses, rather large mouths, and fine white teeth; they have very little beard. The work at the shadoof develops muscle, and they have fine forms and elastic and springing action. The women, from childhood, bring water in huge jars from the Nile, and this gives them a splendid development and graceful movement. They are patient, industrious, and as poor as any people on earth. Their houses are little huts, the walls of which are all made of the Nile mud baked by the sun. They need no roofs except for shade, and they get that by laying sorghum stalks across the walls. They sit and sleep on the ground floor; they have no doors or

windows except sorghum stalks, wattled together; no furniture except a few earthen jars and pots. They do not suffer for food, and only need fire for cooking. Bread made of millet or sorghum seed, with milk, cheese, eggs, vegetables, dates, etc., comprise the common food. They do not drink spirits; their luxuries are tobacco and coffee. Their dress is a plain blue cotton frock, from the neck to the knees. The men wear a turban of white cotton cloth; the women a dark scarf of camel's hair so disposed as to nearly cover the face. In cool weather the frock or robe is of woollen stuff of domestic make, the color of the brown sheep. They are usually barefooted; if shod they wear a slipper. The older people look worn, weary and discouraged. Four-fifths of the people are Mohammedans; of the remainder there are a few Jews, and about a million of ancient Egyptian Christians or Copts. The Jews and the Copts are by far the most flourishing inhabitants. They are the best educated, and for that reason have important employment under government. They have the best houses in the towns and cities.

The winter climate of Egypt is the finest in the world. The air is absolutely dry, and from November to March cool, sweet and bracing. In the early morning the glass shows about 50° Fahrenheit; this may rise at mid-day to 65° to 70°. Exercise on foot or riding camels or asses is never irksome; labor is performed with ease, and all the natural conditions of life are favorable to man. The prevailing winds are from the north and west. The sun rises clear, and all day pursues his course through a cloudless sky, blue as that of Italy. The sunsets are more glorious for beauty of color and golden light than those of the south of Europe. Fleecy clouds of vapor, of a transparent rose color, without shadow, float about the sunset. The sands of the Lybian desert reflect this glow, and all the air seems luminous. When the sun is gone, and dusk comes on, a green tinge mingles with the dark blue of the upper sky; then a strange return of light suffuses the heavens with a roseate flush. This heightens in the east and gradually darkens in the west, and then all fades into the night. At midnight the sky is ablaze with stars, and the brilliance of the night is beyond the power of description.

Dr. Loring. What use is made of sorghum in Egypt?

Mr. Russell. It is used as fuel, and to make doors and roofs for their huts. The seed is fed to cattle and fowls, and also ground and made into a coarse bread.

Question. Did you ever taste the bread?

Mr. Russell. Yes, sir.

Question. Was it good for anything?

Mr. Russell. It was sweet and wholesome bread. I never liked rye or Indian bread very well; and I think that I could have eaten as much of this, if it had been made clean and baked in a good oven, as I could of rye bread without butter.

Dr. Loring. Any sorghum sugar made there?

Mr. Russell. There is no sugar made from sorghum in Egypt, from the fact that the sugar-cane grows abundantly upon planting. It is not a spontaneous growth, because the two or three months of inundation and the long drouths kill it.

Question. Did you drink any of the milk?

Mr. Russell. Yes, sir; I drank the milk freely. I used to drink milk in the morning in my coffee, and I liked it. It had quite a strong taste. We got an abundance of cream, and apparently honest, clean-looking milk. I never went to see where it came from.

Question. How wide is the portion that is inundated?

Mr. Russell. The valley of the Nile does not average, taking in the delta, — and the delta is something more than a hundred miles wide in places, — the valley of the Nile, from the Mediterranean to the first cataract, does not average ten miles in width. Frequently it is not more than a rod in width. I have ridden over a plain of beautiful land, covered with crops, six or seven miles, until I came to the desert. The desert is always encroaching. The sands of the desert are blown towards the cultivated land, and gradually cover it if it is not kept out of the way, and irrigation properly provided for.

"The Farmer is the Man that feeds us all" was then sung by Mr. George C. Rice, Mrs. G. A. Wason, and Mr. and Mrs. Fred Midgley. The audience manifested their pleasure by an encore, which was responded to by a duet from Mr. Rice and Mrs. Wason.

The CHAIRMAN. The gentleman who has addressed us this evening feels a little tired, and, as the hour is getting somewhat late, I think it is perhaps better to dismiss the meeting at this time.

Mr. WARE. Before the adjournment, I would move a vote of thanks to Mr. Russell for the very interesting address he has given us.

This motion was seconded, and carried unanimously.

Mr. HERSEY. I move a vote of thanks to the singers.

The motion was seconded, and carried by acclamation.

Adjourned to Thursday, at 9.30.

# THIRD DAY.

The meeting was opened at 9.30 A.M., Hon. JAMES W. STOCKWELL of Sutton in the chair.

The CHAIRMAN. Members of the Board and fellow-citizens, I have been requested by Mr. Hartshorn to act as chairman during the forenoon session. The lecture this morning will be upon "The Horse," by Mr. C. M. WINSLOW of Brandon, Vt., a member of the Vermont State Board of Agriculture.

## THE HORSE.

BY C. M. WINSLOW OF BRANDON, VT.

The breeding of horses is a pursuit that has always received much attention, both from the laboring and the sporting classes of mankind; for to each are good horses necessary, — the one for support, the other for pleasure.

I have been asked to say something to you to-day about the horses that are best adapted to the wants of the farmers of Massachusetts, and I was kindly allowed to touch on other classes, and permission was granted me to even take a turn around the race course, — with a farmer's horse, I suppose. Now, as Massachusetts is not far from Vermont, and as I was permitted to do a little trotting while not busy at work, I will take for my subject the American roadster, as combining all the necessary requirements for a horse of all work while on the farm, and a mortgage lifter when sold.

The American roadster, like the American people, is a combination of all that is good from the mother country, and the world at large; and there are no horses in the world to-day, that, for pleasant disposition, good style and enduring qualities, will compare with the horses of New England and New York. A part is due to the original blood that lies back of them, a part to the food and climate

of New England, and a part to their training for generation after generation.

My remarks here to-day are intended particularly for the farmer that raises one or two colts each year, and depends on the horse stock of his farm to do its work, and, when sold, to leave him a margin of profit. As the work of the farm is varied in its character, requiring one strong enough to plough a few acres, fleet and strong enough to take the produce to market or the family to church, I will make the standard of a farm horse, from 15 hands 1 inch to 15 hands 3 inches high, to weigh from 1,000 to 1,100 pounds; a horse of kind, pleasant disposition, and at the same time having a large amount of nerve power and energy, full of life and ambition; a head of moderate size, clean and bony; a full, pleasant eye, that stands out in his head; a thin, clean ear, that stands well up, and works quickly when on the road; a clean neck, short back; strong loins, with the hips firmly placed; shoulders somewhat oblique; roomy barrel, with ribs well sprung, and closely ribbed up; legs of medium length, short rather than long; flat bone, with cords that stand out prominently; and large, strong arms, with a muscle that lays well out to view; feet strong and hard, well arched on the under side, and of medium size. A horse of this kind would not answer for heavy teaming in the quarries, nor for heavy dray work in the cities. He would not endure the slow, tiresome work of ploughing day after day; but he is admirably fitted for the average farms that have a variety of work, and must be shifted from one to the other frequently. This style of horse is always in demand for gentlemen's drivers and carriage horses, though usually the carriage horses should be from 15 hands, 3 inches to 16 hands, and weigh from 1,100 to 1,200 pounds; but otherwise the same style as described above. I have said nothing about the action, as I will speak of that later. One great advantage of this style of horses is that this class is native to New England, adapted to the soil and climate, and the breeding of them is no new experiment. Another reason why I advise the farmer to raise this class of horses, is that the market is never over-stocked with them, and the market is right at your own door. With almost any other farm

product, it is necessary to send to the city to find a market; but, with this class of horses, buyers will come to your door; they will follow you out to the plough field or meadow, and the farmer is at no expense except the loss of his time while showing them. He should ask a good price for them, but he should never let a buyer go away without the horses if he has made a fair offer for them; and the younger they can be disposed of the better, if it is money and profit you are seeking for.

The original horses of New England were brought over by the early settlers, and mostly from England. After the country became more settled, a better class of horses was brought over, and quite a number of thoroughbreds, to improve the running horses; and they were used to some extent on the common mares of the country.

Perhaps the most noted importation, and one that has left the greatest influence on the road horses of to-day, was that of Messenger, an English thoroughbred, foaled in 1780, and imported in 1788. He stood for a while in Pennsylvania, and the remainder of his life in various parts of New York, with the exception of one year in New Jersey. Messenger was gray, 15 hands 3 inches high, and stoutly built. He was not what would be called a handsome horse, but was a horse of wonderful power. It is said of him that during the voyage to this country the two horses that were imported with him became so reduced that they had to be helped from the boat; but when it came Messenger's turn, he dashed down the gang plank at a stiff trot, with a groom on either side, and in spite of them he trotted some distance up the street, taking them along.

There is another horse that has left his name and mark on the road horse of New England, who, about the same time that Messenger was on his way to this country, was being led behind a wagon from Springfield, Mass., to the hills of Vermont. Little did the people realize the value of that little colt as he trudged along, and what a power lay in the loins of Justin Morgan, when crossed on the Vermont mares. He was said to have been sired by True Briton, a horse stolen from the British General DeLancey during the Revolutionary War. True Briton was sired

by imported Traveller, he by Morton's Traveller, a horse that, while called an English thoroughbred, was in fact an inbred Arabian. Linsley, in his history of the Morgan horse, describes Justin Morgan as follows: —

"The original, or Justin Morgan, was about 14 hands high, and weighed about 950 pounds. His color was dark bay, with black legs, mane and tail. He had no white hairs on him. His mane and tail were coarse and heavy, but not so massive as has been sometimes described; the hair of both was straight, and not inclined to curl. His head was good, not extremely small, but lean and bony; the face straight, forehead broad, ears small and very fine, but set rather wide apart. His eyes were medium size, very dark and prominent, with a spirited but pleasant expression, and showed no white around the edge of the lid. His nostrils were very large, the muzzle small, and lips close and firm. His back and legs were perhaps his most noticeable points. The former was very short; the shoulder-blades and hip bones being very long and oblique, and the loins exceedingly broad and muscular. His body was rather long, round and deep, close ribbed up; chest deep and wide, with the breast-bone projecting a good deal in front. His legs were short, close jointed and thin, but very wide, hard and free from meat, with muscles that were remarkably large for a horse of his size, and this superabundance of muscle exhibited itself at every step. His hair was short, and at almost all seasons soft and glossy. He had a little long hair about the fetlocks, and for two or three inches above the fetlock on the back side of the legs. His feet were small but well shaped, and he was in every respect perfectly sound and free from any sort of blemish. He was a very fast walker. In trotting his gait was low and smooth, and his step short and nervous. He was not what in these days would be called fast, and we think it doubtful if he could trot a mile much if any within four minutes, though it is claimed by many that he could trot it in three."

This horse was kept in various parts of Vermont until his death, and impressed his sterling good qualities on his colts from all classes of mares; and to this day the influence of old Justin Morgan may be seen on many a road

mare in the State. There are a number of families of sturdy Morgans tracing to the old horse, but perhaps the most famous is the Lambert family, tracing back through Ethan Allen, Vermont Black Hawk and Sherman Morgan, to Justin Morgan. This family seem to have developed a larger size and more speed, as a rule, and are sought for as driving and carriage horses, being of good size, good disposition and stylish. Most of the Morgans, aside from this family, are undersized for the horse of to-day. They have every other good quality desired in a general-purpose horse except size; but the descendants of Justin Morgan, crossed with the descendants of Messenger, make the best kind of a horse for our eastern farms, and sell readily as drivers and carriage horses; and the more Morgan blood the better, provided the desired size is maintained. Formerly there was a strong rivalry between the Hambletonian and Morgan families; but recently this feeling is dying away, because it has been found, in tracing the lines of most of our fastest trotting horses, that there was a strong dash of Morgan and Messenger blood in them: such as Nelson, 2.10¾; Guy, 2.10¾; Jack, 2.12¼; Belle Hamlin and Justina, 2.13 to pole; Pamlico, 2.16½. George Wilkes, the noted sire of trotting horses, has a strong infusion of Morgan blood on the side of his dam. Axtel, 2.12; Johnston, pacer, 2.06¼; H. B. Winship, with running mate, 2.06; Westmont, with running mate, 2.01¾.

While I would not advise farmers to breed entirely for speed, I do believe it wise to cling to the large type of horse of the Morgan or Hambletonian families, because in these families are found the best horses not only for trotting, but for carriage horses and gentleman's drivers; and, if the size is strictly adhered to, they will also do all the work on the farm. In raising a colt of this kind, you have several strings to pull for a sale. If, by chance he prove a trotter, he will bring a good price; if he is not fast enough for that, and is a stylish walker, he will sell for a gentleman's driver; if he cannot go quite fast enough for that, he will sell for a carriage horse; and, if all these fail, he is of value for a work horse.

If you propose to raise horses of this pattern, the selection

of the brood mare is all-important; and a few dollars extra, paid to secure a good mare, is money well spent, for the extra is divided between a number of colts; and a good mare is liable, in the extra price of one colt, to pay many times over the extra paid to secure a good dam at the start. The mare should be in herself all that is wanted, save perhaps extra speed. She should at least in that be a good driver. She should be not less than 15 hands high, — 15 hands, 2 or 3 inches would be better. She should weigh not less than 1,000 pounds, — 1,100 or 1,200 would be better. Of good natural style, sound in wind and limb, with a strong constitution. She should have a pleasant disposition, kind, and willing to do what is told her, but with a powerful will and great nerve power; a mare that needs no whip, and one that, however tired she may be from a long, hard drive, will respond with renewed energy to the voice or a touch of the line.

I lay this great stress on the mental organism of the brood mare, because it is needed to give courage and energy to her colts. I do not like vice or ugliness in a brood mare; but there is a wide difference between a high-strung, nervous mare, and a vicious one. A vicious mare may be high-strung, but a high-strung mare is not necessarily vicious.

It is this nervous energy that makes our smartest men and our best horses, and I believe they inherit it largely from their mothers. Perhaps I may make my meaning better understood by calling it grit or determination. Many a time we see men of less natural ability outstripping their superiors, simply from their determination and will power. So in like manner we often see a horse of less natural speed win a hard-fought race simply from his grit and determination to hold on, and get there every time if possible. It always tells in the long-fought battles, in human life and on the race track and in the daily routine of hard work.

How we all prize a horse that always lets us feel that there is a little reserve power back, which we may have by calling for it. All this the brood mare should be in herself, and back of her she should have as long a line as possible of this class of horses; the more there are the less will be the chance of loss in breeding, for it is a law of nature that like

begets like. It may be of immediate ancestry, or more remote; but blood will tell. In selecting a horse to couple with such a mare, it would be well to choose one possessed of similar qualities and equally good size. While perhaps the disposition in a stallion is not so important, I much prefer a pleasant one. Circumstances may have made a naturally good-tempered horse unmanageable, which, while it is to be regretted, may not disqualify him. If there are any defects in the mare, care should be taken that the same are not found in the horse; for, if they both have the same defect, it is almost certain to appear in the colt.

The care of the mare while carrying the foal is often overlooked; nevertheless, it is of great importance. She should not be fed fattening food, but should have an abundance of nourishing food, such as contains a large percentage of bone and muscle producing qualities. She should have moderate and regular exercise, either by a run in a large yard, or by driving. It is difficult to produce a strong, courageous colt from a mare over-worked or half-fed during pregnancy.

As soon as the colt is dropped, care should be taken to give it a continued and steady growth; and its training should begin very early in life, getting it accustomed to being handled and led by the halter. The early growth and early training are what determine the future of the horse. A critical time in the life of a colt is at weaning time, which should be at about five months old, before which time he should have been taught to eat oats or bran, and when weaned should have a liberal allowance, giving him all he will eat for a week or so, until he ceases to mourn for his dam.

An excellent food for colts just weaned is sweet skim-milk, warmed to the natural temperature. If offered to them about twelve hours after being taken from the dam, they will usually take a little, and will soon learn to drink readily. If they do not take hold of the milk, give them no water and offer only milk, and they will soon learn to drink the milk. About two quarts a day regularly will make a marked difference by spring.

As the raising of horses is for the purpose of obtaining money, the colt should be for sale any time; and, when a

fair price is offered, the colt should be sold, unless it may be desired to keep it for breeding purposes. The owner should take pains to find out the quality of his colt prospectively, which he can usually do by watching him at his play, while following the dam; and as he grows older he should be gradually trained to the harness and a light hitch, until old enough to do some work; but he should never be put to long-continued, exhaustive work until matured. The ordinary light work of the farm is, I believe, the best kind for training a colt, for working beside a steady horse teaches him to be steady and reliable, and exercises all the muscles, and is far better than standing in the stable or driving on the road continually. In this way the disposition and good qualities of a colt will gradually display themselves, and the owner will be able to form a very good idea of the future of the colt.

If he has the appearance of being very fast, there is danger of ruin,—not to the colt, but to his owner. He should stoutly resist all temptations to place him in the hands of a trainer, to develop, for as soon as he begins he will find expenses have begun; hopes of a large sum of money will be continually held out as a bait, and continually will the expense accumulate, until the colt has eaten himself up, and the owner is fortunate if he has not eaten the farm and stock besides. The farmer should be a breeder, and confine himself to that; and, when a colt goes out of his hands, let it be an actual sale, with its fair equivalent in money. I would advise him to sell his best colts, if possible, where they will be trained for all they are worth. If he has the dam at home, and more colts following along, the chances are that the colts will be looked after, and the price will increase as his colts prove valuable; but on no account whatever should he develop them himself. A wealthy breeder that is farming partly for profit and partly for pleasure may do as he likes; but with the ordinary farmer the colts may be used to pay the mortgage, or as easily used to add to it. There is a great deal of pleasure in raising a good colt or two each year, and watching them develop; many a dream, too, will flit through his mind as he sees him now and then with arched neck and distended nostrils leading

the race in the pasture, or when on the road something startles him, and he strikes into a rapid trot, and squares himself away as for a race. Some of the neighbors, too, will see it, and fill his ears with the visions of an Axtel and a hundred thousand dollars. But let him beware; let him show the speed of his colt along the road about his own business all he can, and in a quiet way work up the reputation of his colt all he can; but on no account lose a good chance to sell for a fair price, nor feel regret at his action if he afterwards hears of his being sold for as many thousands as he got hundreds. Let him feel that he has made his profit, and be willing and glad that others made theirs, and invite them to come again, and buy more and better ones, at a little higher price. Do not try to get all the profit, for the great expense of fitting and training horses comes after they have left the breeder's hands, and the risk, too; for only a very small proportion ever become famous.

A very profitable way to dispose of horses is to get a pair together, and let them do the farm work, and when old enough sell them for carriage horses. There are many ways in which horses on the farm may be bred with profit, if bred carefully from good stock, and sold when ready for market. On our large horse-breeding farms great stress is laid on early development, and a colt is forced from birth. This of course makes large horses early, and is all very well for those who are farming for pleasure, or raising horses for the track; but it is an expensive way to raise them. While I would strongly urge the farmer not to starve and dwarf his colts, I believe a medium course would in the end prove more profitable, and maintain the good qualities and hardiness of his horses. It may take a year longer to grow them, but will cost less in the end. The first winter of a colt's life is the most important, and he should be fed liberally, kept warm, and have plenty of exercise.

The Chairman. Gentlemen, you have listened to this very interesting and instructive paper, and Mr. Winslow is now ready to answer any questions. The subject of feeding and breeding is always a very important one, for the good breeder, in whatever line, is to a certain extent a creator.

As we look back over the list of the Board of Agriculture of Massachusetts, and note the names of those who, as breeders and as improvers upon the different lines of agriculture, have been benefactors of their country, it is a source of satisfaction and pride to us. The wild rose of a few years ago has been developed into marvelous forms of beauty. The roadside aster, which I think finds its natural home in Worcester County, has been developed into the many-hued flowers of that variety which now adorn our gardens and give pleasure to multitudes. In the line of the horse, the speed of the trotting horse, as has been suggested by the lecturer, has been increased from a mile in three or four minutes to a mile in two minutes and eight and three-quarters seconds. In neat stock the improvement is something wonderful. So that the true principles of breeding are very important indeed, especially with reference to the subject which we are considering to-day; for I believe horse breeding is a valuable industry to the New England farmer, and therefore I expect there will be very many questions asked and answered. But first we would like to hear what Dr. Twitchell has to say upon the subject.

Dr. Twitchell. Mr. Chairman and gentlemen, you bore with me so patiently yesterday that I do not feel that I ought to inflict myself upon you to-day; but I would say a word upon this question, because it is one in which I am intensely interested, and relates to a line of work in which I have been engaged for several years, not in breeding or selling horses, but in trying to assist others in breeding choice stock.

I never knew a bright man or a bright horse that did not have a good mother. Take that home with you as a good maxim, and in your breeding, I care not in what line, be sure that you have a good mother. That little mare that was spoken of that came upon the track almost unknown to any of us we found afterwards had a mother of real worth, although she did not come from any popular strain of blood, and that mother gave to the colt the power of endurance and success. I believe to-day in horse breeding, and I want to commend and endorse every statement of the lecturer. I think he has given you something real and substantial,

something that may be made helpful in your lines of work. The only criticism I have to make is that we ought to spend two or three days upon the subject of this paper. He has thrown out many hints, upon any single one of which hours might be spent with profit. Special lines of work for special men is a point that cannot be too strongly emphasized, and it applies as truly to the breeding of horses as to any other line of work. It is true with us and it is true with our stock, that nature seeks at all times to preserve an equilibrium, adapting the man, or the animal, to the condition in which he is placed. This is something which we have not appreciated in the past as we ought. Take a stock horse in Kentucky and bring him to Maine, and what is the result? Within four weeks his hair thickens, and he begins to adapt himself to his environment. And just so in the reverse condition. That is a fact which we should bear in mind. I think it is time that we gave up breeding for the all-purpose horse, or breeding on different lines. Successes are not to be found there. The man who has a love for trotting stock should breed that stock; the man who has a love for a draft-horse should breed in that line. We should all try to succeed in the line of work for which we *ourselves* are best adapted, and if we do we can feel well assured of success.

Upon a farm in New Brunswick I have found Percheron colts growing like flocks of sheep, a dozen or fifteen in a paddock together, feeding upon the coarser fodders, with oats and roots, and making substantial growth. You cannot grow a trotting horse in that way; you cannot grow high-strung, nervous colts in that way. Each one must have a pen by himself. The dangers of accident are too great. So you see there are two sides to this question of breeding. There are men in Massachusetts to-day who could make more money in breeding large draft stock and driving stock than in breeding trotters, because they are not adapted to that special work; they do not appreciate all the lines that enter in and control it.

There is one other thought. I wished, while the speaker was giving us his admirable lecture, that we might have had a horse upon the platform. In my own work, when I am

speaking upon this question, I insist, whenever it is possible, upon having a horse before me, so that, as I attempt to outline my thought, I may place my hand upon the part, and show what I mean by "conformation;" because a horse, as Governor Hoard so clearly brought out in regard to the cow, is adapted for some special line of work in his formation. You would not take a horse for a trotter with a short hip, a heavy leg and a straight pastern. You could not make a trotter of that horse. A trotting horse should have a round, full nose; an open nostril; firmness in the mouth; clean-cut jowl; an intelligent face, broad between the eyes; a full, round, expressive eye; a neck of good length, and well arched; oblique shoulders; the point of the withers well back under the saddle; a well-muscled fore-arm; a strong knee; a flat, short cannon bone; a springy pastern, with an angle of about forty-five degrees; a short back, with coupling well forward; heavily muscled over the loins; a long quarter, well developed, allowing free stifle action; a clean-cut hock, neither straight not sickle-shape; a body deep in barrel and waist, and a good foot. There must be the oblique shoulder, to allow the horse to reach out with the forward feet; and there also must be a long quarter, to insure length of stride in the propelling parts, — the hind legs. A draft-horse should be stronger built, straight in the shoulder, the shoulders well apart at the top, a rounder barrel, a shorter quarter, a stronger leg and a straighter pastern. There must be a conformation best adapted to the wants and needs of the animal, and it is for this that we should seek. When we bring these extremes together, we must lower materially the standard of perfection in both.

I do not wish to take up the time, but I will say that I think we ought to study closely this question of formation. During the past season I have assisted in passing upon nearly a thousand horses and colts, and it has been surprising to me to find how this matter of form controls action. In our own State, passing upon some six hundred horses and colts, scoring them as individuals by use of a card, we found in certain lines of breeding, and with certain horses and mares, surprisingly uniform results. Now, in breeding a high-class horse, one thing is to be avoided, and that is,

cold blood in the dam. It will show itself to your disappointment, and you know not where. There are some things that we cannot control in breeding; there are some things which we do not appreciate; there are some things for us yet to reach after. One of the uncertain things is that, in mingling bloods, in bringing horses together which are cross-bred, we cannot tell which is to control, and whether in the union the best results can be attained. But I will give this rule as a safe one to follow. When you have bred a brood mare to a horse, and have got a colt which pleases your fancy and which promises to be of value, follow that breeding year after year, and every colt will increase in value. Hold to that coupling just as long as it is possible for you to bring those two animals together. I think in doing this we shall find that there is success in our work.

Gentlemen, if you have not put into the hands of your children and carefully read yourselves that little volume called "Black Beauty," I advise you to procure a copy and read it carefully. I tell you that when you go into your stable the next morning and put your hand on the head of your horse, you will feel that you must give him better care and more kindly attention. You will feel that a horse is an animal worthy of your respect.

In New England, where so much capital has been invested in horses, and so many valuable animals have been brought in for sires, it is time we had legislation prohibiting the use of unsound stallions. If you have not such legislation, as I hope you have, you ought to have it, for the protection of farmers who, in the pressure of many duties, are unable to give the time necessary for the thorough study and appreciation of this question. I maintain that we should prohibit by legislation the use of sires which are unsound, because the margin of profit to-day will not admit of chances being taken.

I was glad to hear one thought that was expressed by the speaker, that we should never break a colt. Why, gentlemen, you can never break *up* anything; you break *down*. In breeding, your aim should be to build up, to educate, to perfect. Nature gives us what? Nature gives us flesh,

blood and bone. Man makes the animal out of his own intelligence and skill, by directing, controlling and building it up through education. I hope that the time will come when that word "break" will disappear from our vocabulary, and we shall insert the word "educate."

A word as to the value of skim-milk. If I was feeding a weanling colt four quarts of oats, with a good hay ration, I would rather reduce that four quarts to two, and put in two quarts of skim-milk, than continue the four quarts of oats. There is no animal to which you can feed skim-milk and find better returns than in feeding it to weanlings; and the growers of horses in my own State are finding the best results in a liberal ration of this valuable by-product.

I wish it were possible to lead the horse Nelson up on the platform, — the "king of the turf" to-day in this country, — that you might see him, if you have not. What a magnificent exhibition of power there is in that horse! He has an eye that looks straight into yours, expressive, full, large, round; a nostril that tells the story of health and vitality in and of itself; a head that is broad and full of intelligence; a neck that is shapely; an oblique shoulder; a straight forearm, and a flat, flinty cannon bone; an oblique pastern; a body that is perhaps a little long, yet as you study the horse you will find in muscular development he is here a tower of strength. His garters are superb, and his hind leg symmetrical and strong. In fact, he has all the characteristics of a first-class horse; and when he moves he is the embodiment of a machine in motion, with a heart and soul that loves to go. If he was standing there before you, you would at once recognize that you were looking at a perfect horse. I speak of him because he is to-day the highest type of the horse that we have in the State of Maine. That is just the class of horse we should be reaching after, and we can secure it in our breeding by studying carefully the formation and temperament of the brood mare and the horse that we desire to couple with her, so that we may avoid extremes. Then, having secured a colt, begin at once to grow and educate for highest perfection at maturity; and, whenever the first offer comes that is satisfactory, that will give you a good return, sell it, even though the colt be only

three months old. If we reach after this class of colts, and breed in this way, success is going to be found in horse breeding as well as in other lines of work.

Professor ROBERTS. I would like to ask the lecturer a question, and with your permission I would like to preface it with one or two sentences. I have listened with a great deal of pleasure to the address, but the subject is so broad that I cannot hope to do more than touch on a few of the salient points.

The first thing which struck me was this, that I would like to emphasize the idea that energy comes from the combustion of carbon. That is nature's plan. Now, energy is worth nothing until you get courage behind it; and therefore, in order to get energy, we must have a good draft to burn the material. So we find that in our fast horses we have the lungs deep vertically and narrow horizontally. That is the law. In the draft-horse the lungs are wide or broad, and rather low vertically, so that the shoulders are wide apart, that the horse may move one side of the load at a time. Any of the old men who have used oxen and were expert in driving them knew enough when they got stuck in a mud-hole to throw a stick of cord-wood under the off wheel of the cart, and gee the oxen off; and when they had got them well "geed" off, they threw the stick of cord-wood under the near wheel, and then "hawed" the oxen, and kept on in that way until they got the cart out of the mud. That is the principle on which the draft-horse is built, with its shoulders as wide as possible.

But I am getting a little off the point I had in mind. We must have courage in the horse if we want a good animal, and combined with that courage must be a good amount of energy to sustain the courage. No matter how much courage he has got, if he has no energy; if he has been without his dinner for fifteen days, his courage does not help him. The whole law must go together, — courage and energy. In order to get energy, he must burn carbon, he must get heat. Now, the difficulty of raising a colt in the winter is, that you give him heat-producing food, energy-producing food, but you do not give him bone and muscle producing food; and the colt in the stable is not to expend

his life in trotting, but in growing. That is the business of the colt. When he gets older, we shall feed him differently.

Now I am coming to my question. If you have a winter colt, the first thing is to see that that colt has enough nitrogen and enough phosphate to grow, and timothy hay does not give it. Our breeders are finding out that they can grow a Hambletonian from ten to twenty per cent larger than the ordinary Hambletonian, simply by following that line in feeding. I can give you the name of a man who will do it. He will breed a Hambletonian that at two years old will measure sixteen hands. He gives his colts plenty of exercise when he is feeding them. So that it is not all in breeding; there is something in keeping.

Now, Mr. Winslow, what I want to ask is this: Why not breed a colt in the fall, instead of in the spring? Why not improve on nature's method, and direct the energies in a better channel by having the colt dropped in the fall, when there are no flies, when we have plenty of time and opportunity to take care of it in a box stall; and when we have plenty of roots stored up for the mare? Any man who knows how to make a cow give milk, will know how to make a mare give milk for a colt. Why not teach that colt to eat so that it can depend upon itself in the spring? We shall have no colt then to follow after the mare, if we want to use her. The colt will go onto fresh grass in the spring, when he is cutting his teeth; he will do that every year, cut his teeth on grass instead of timothy hay; and when he comes out in the spring he will not have hair several inches long on his abdomen until June. Now, why shall we not make a change in this matter? You are an expert in this direction. We have practiced this plan with very great success.

Mr. Winslow. That is a practice that is being adopted of late. I have two mares that are served to foal next fall. I cannot tell you anything about it from my own experience, but a good many tell me that they do not like it very well, because the colt sheds his hair at the wrong time of year; and they think he does not grow as well in winter, with the best care, on account of the cold, as he does in summer. But, as I say, I know nothing about it; I simply state

what others have told me. There are advantages that theoretically would influence a man to adopt this plan. One advantage has been suggested, — that of having the mare to work in the summer, and the colt to grow in the winter and to cut his teeth on grass. It looks as though it might work well. I have told you that which I think is true either from my own personal experience or from close observation, but I do not know much about this matter.

Professor ROBERTS. Is it true that a fall colt sheds his hair at the wrong time of year, or differently from others? I do not know whether it is the fact, or not.

Mr. WINSLOW. I simply state what has been told me. I never have had a fall colt, and do not know.

Mr. PETERSON. Will you tell us about the feeding and watering of our working and traveling horses?

Mr. WINSLOW. I think that horses that are working should be fed according to what they are doing. A feed of oats for young horses and for driving horses I think is better than anything else. It is a bone and muscle producing food. I think a horse that is working should be fed according to his labor. In regard to watering, I would water a horse before I fed him. Horses should not be watered when they are warm; you may safely give them a few swallows of water. You can hardly lay down a rule for the feeding and care of horses on one general principle. Horses that are doing heavy work may be fed meal, while a horse that is used for driving purposes would be better fed with a different kind of food. I do not think it is well to feed a horse very heavily with hay. His stomach is small, and he should be fed oftener than a cow. A horse should not be crowded with food, but be fed a little good food at a time. Horses will do just as well, and better, on less food fed regularly, fed methodically, than they will if they are fed in the old-fashioned way of trying to have them eat the haystack down.

Dr. TWITCHELL. Did you, in your recommendations as to early training, intend to convey the idea that you believe in driving a colt to harness before it is a year old?

Mr. WINSLOW. I harness my own colts the first winter. I do not hitch them to anything, but I put the harness on

them, and drive them. They thus become accustomed to the harness, and get a little needed exercise in that way. When they are a year old, I hitch them to a very light rig and drive them a little. I do not believe in driving a colt until he is tired. I never put a bitting bridle on a colt, and go away and leave him. My time is worth too much to do that. I stand by, and when he shows any indication of being tired, I take the bridle off and put it on again after he is rested. You cannot teach a tired colt anything, any more than you can teach a mad boy. I try to make my colts feel that I am their friend, and that they can have confidence in me. I would not let any long interval pass in the summer without having the harness put on them. I accustom my colts to having the wagon come up against them. They know I am there, and it is all right.

Mr. PIERCE. I would like to ask as to feeding dry or moist food.

Mr. WINSLOW. I like dry feed. Moist feed does well enough, I think, for people who like it, but I prefer dry feed. I like to have my horses chew their food. But, in the case of a horse that will bolt his oats, I would crush them. You cannot lay down any general rule; you have got to know the horse.

Mr. PIERCE. Don't you think it is the better way to feed moistened, cut feed, in case they eat slowly?

Mr. WINSLOW. I think dry feed is better. I think the horses are less liable to suffer from indigestion, and less liable to have wind colic, where they are fed on dry feed.

QUESTION. Don't you think that a mare that is worked moderately and regularly on the farm produces a healthier and more thrifty colt than one that is kept in idleness?

Mr. WINSLOW. Yes, I do. I think that a mare ought to have moderate exercise. Of course in the large breeding establishments a man cannot do it; but with one or two mares he can work them moderately through the winter, and he will be more likely to get strong, healthy, courageous colts than if the mares were kept in a box stall without exercise.

QUESTION. Do you use a bitting bridle?

Mr. WINSLOW. I like to teach a colt to obey. I like to

have a colt that I can drive without pulling his head round. I think that you can teach a colt in a short time by using a bitting bridle, so that when he feels the rein he will turn his body without turning his head. I may be mistaken, but that is my idea. I would like to get rid of that method if I could.

QUESTION. Do you think it is wise to use a mare to breed from after she is past twenty?

Mr. WINSLOW. I was told, by a man up in the northern part of the State, that he bought a mare that was said to be too old to breed. The man of whom he bought her said she was eighteen years old, and was of no value, and he bought her for fifty dollars. She was a well-bred mare, and had produced some nice colts. He told me she was then twenty-five years old, and he had raised five or six colts from her. I see no reason why a mare should not breed, so long as she will breed good colts. Some of the colts from our old mares have been among the most valuable colts in the country.

Mr. BANCROFT. If a mare is spavined or wind-broken, is she not liable to transmit that weakness to her progeny?

Mr. WINSLOW. I do not like to breed from a spavined mare. A mare may have a spavin, the result of accident, but I think it will be likely to be transmitted. I had a very curious illustration come within my personal knowledge. I am a breeder of Ayrshire cattle. I once bought a bull for another man, under price, because he had a broken tail. I thought that was no special damage to the animal. Afterward I bought the bull, and used him in my own herd. The result was that I kept having broken-tailed calves. I sold him to Mr. Peter Smith of Andover, Mass., and he told me that he liked that bull very well, but said that every now and then he got a calf with a broken tail. I know that spavined mares are liable to have spavined colts, or to give to their colts a predisposition to spavin. The colts may never be subjected to a strain which will give them a spavin, but they are not in as good a condition to resist a strain, from having had a spavined mother. Why, gentlemen, you know that we inherit from our parents all sorts of ills; and why should not a colt? I would use a sound mare for breeding, and by all means a sound horse.

Mr. F. H. Appleton of Peabody. I would like very much to move, if it is in order, that a committee of three be appointed by the Chair, who shall consider the advisability of this meeting passing a resolution recommending the enactment of a law prohibiting the use of unsound sires in Massachusetts, the committee to report this afternoon.

Mr. Ware seconded the motion, and it was carried.

The chairman announced the committee as follows: Messrs. Appleton of Peabody, Sessions of Hampden and Ware of Marblehead.

Adjourned to 1.30 P.M.

## Afternoon Session.

The meeting was called to order at 1.30, Mr. Stockwell in the chair.

The Chairman. Is there any business to come before the meeting before the address by Mr. Gold?

Mr. Hersey. I move that the thanks of the Board be given to the Worcester Agricultural Society and to the Worcester Grange for the courtesies which they have shown us since we have been here, and also to the Worcester Horticultural Society for the free use of this hall, which is so well adapted to our purposes.

Secretary Sessions. Personally, sir, I wish to acknowledge my obligations to the members of the Worcester Society for the aid they have given me in making arrangements for this meeting, and for the courtesies which have been extended to the Board, and to me as its secretary. The thanks of the Board are certainly due to the Worcester Horticultural Society for the free use of this beautiful hall, and the kind attentions of the officers of that society.

The motion of Mr. Hersey was carried, by a unanimous vote.

The Chairman. Is there any other business that any member desires to bring before the Board at this meeting?

Secretary Sessions. I want to say that the forces of nature have prevented you gentlemen from having an invitation which I doubt not you would have received with great pleasure. The Worcester Agricultural Society had intended

to invite the members of the Board after the lecture this afternoon to take a ride about the city, and view some of the attractions of Worcester, of which they are so proud, and which you would have very much enjoyed; but the ice storm of this morning has made the streets unsafe for the smooth-shod horses, and thus prevented the courtesy being extended, for which I am very sorry, and which I doubt not you all very much regret.

The CHAIRMAN. You will now listen to the report of the committee appointed at the forenoon session with reference to legislation in regard to the use of unsound horses as sires.

Mr. APPLETON. The committee understand that the last Legislature passed a law requiring that the pedigree of stallions, advertised for service, should be recorded; and the committee recommend that an addition be made to the law in some form, providing that proof of the soundness of the horse shall be certified to by a veterinary surgeon.

Mr. WARE. I understand that it is proposed that the legislation shall forbid the advertising for service of unsound stallions, and this certificate is to be proof of soundness.

Mr. E. W. WOOD. I would move that this committee be instructed to bring this matter before the Legislature.

Mr. NEWTON. I would like to inquire if it is the intention of this Board to ask the Legislature to forbid by law the use of an unsound stallion? If so, is it a wise move for an intelligent set of men like those here present to make? What would such a law amount to? It seems to me that it would simply make us a laughing-stock. How can you, by a law of Massachusetts, forbid me to use a stallion that I have, if he does have spavin? How can we enforce any such law? Have we not on the statute book any number of laws that are inoperative? What is the use of incumbering it with more?

Secretary SESSIONS. I do not suppose that this convention has any idea of undertaking impossibilities; but I do know that the Legislature, by their action last winter, considered that they had a right to require information respecting horses kept for breeding purposes. Now, an addition can be made, requiring that the owners of horses offered for service shall show that they are sound. I can see no harm

in passing this resolution, for of course the Legislature will be the judge as to whether they will enact such a law, or not.

Mr. Ware. Of course this law is not to be understood as applying to a man who keeps a stallion for private use. But the stallions that are advertised and put upon the market for service can be reached, and it is proper, it seems to me, that the farmers should be protected from the service of an unsound stallion that is liable to impart that unsoundness to his progeny. If a private individual chooses to use his stallion in a private way, of course this law would not reach him, and it is not intended to do so; but it is intended to reach publicly advertised stallions that are on the market as such. I say that it is not too much to require that such stallions shall be sound.

Mr. Chamberlain of Worcester. I object to the passage of the resolution, on general principles. It is special legislation. It is the opening wedge which will be made use of in the future, if it is sanctioned by this meeting, for all kinds of restrictions upon all kinds of farm animals. It appears to me that the law of the survival of the fittest, the law of self-protection, which has had control of this matter in the past, is sufficient to control it in the future; and, as special legislation, and as leading to what it appears to me is very objectionable, I hope the resolution will not pass.

Secretary Sessions. The opening wedge was started generations ago. We have a law on the statute book that has been there for many years, providing that rams shall not be allowed to run at large at certain seasons of the year.

Mr. Appleton. I understand that in the State of Indiana it is required that in all advertisements of stallions standing for use a certificate of soundness from the State Veterinary Surgeon shall be published with those advertisements; and I believe it is also the law in France, where they are so noted for their horses of various kinds.

The Chairman. It seems to me that we may trust this matter with a committee such as we have appointed to have charge of it. They will, doubtless, if they bring anything before the Legislature, bring something that will be of benefit to the breeders of Massachusetts.

Mr. CHAMBERLAIN. It appears to me that, if we are to have a certificate of the soundness of the sire, we should also have a certificate of the soundness of the dam. These imperfections are transmitted perhaps more generally through the dam than through the sire; and why should we not have a certificate of the soundness of the dam, as well as of the sire?

Secretary SESSIONS. The law of last winter reads as follows: "The owner or keeper of any stallion for breeding purposes shall, before advertising by written or printed notices the service thereof, file a certificate with the clerk of that city or town in the county in which said stallion is owned or kept, stating the name, color, age and size of the same, together with the pedigree of said stallion as fully as obtainable, and the name of the person by whom he was bred. And it shall be the duty of such clerk to record such certificate in a book kept for that purpose. Copies of such certificate duly certified by such clerk may be used in evidence the same as the original in any court in the Commonwealth. The fee of the clerk for recording each certificate shall be twenty-five cents. Whoever neglects to make and file such certificate shall recover no compensation for the services of his said stallion, and if he knowingly and wilfully makes and files a false certificate of the statements aforesaid he shall for each and every offence be subject to a penalty of one hundred dollars."

The CHAIRMAN. The question is now whether this Committee shall be instructed to bring this matter before the Legislature, and request legislation upon it.

The question was then put, and resulted in a vote of fifteen in the affirmative to eight in the negative.

Mr. APPLETON. I suppose the members of the Board only have a right to vote.

Mr. DUDLEY. It seems to me it ought to be understood whether any but those who are members of the Board have a right to vote. I did not vote, because I am not a member of the Board.

The CHAIRMAN. We would be very glad to have a full expression from all those who are in favor of, and all those who are opposed to, the resolution. We are here in conven-

tion, and I will decide that all in the hall who desire to vote on one side or the other shall have the privilege. Before asking you to vote upon this question, I will read the motion, as amended by the committee: "That proof of the soundness of a stallion advertised for service should be required by law, and that such proof should be a certificate from a veterinary surgeon, and that the committee already appointed shall be authorized to act for this convention before the Legislature."

Mr. SHAW. Is this to go forth as the vote of the Board of Agriculture, or of the convention?

The CHAIRMAN. The vote of the convention. I rule that all who are present in this meeting have a right to vote. All those in favor of this resolution, as now amended and read, will rise, and stand until counted.

Thirty-five having voted in the affirmative and seven in the negative, the chairman declared the resolution carried.

The CHAIRMAN. As the time is getting late, unless there is other business to come before the meeting, we are now ready to listen to the address from the secretary of the State Board of Agriculture of Connecticut, upon the question, "What can Legislation do for Agriculture?" I have the pleasure of introducing Mr. T. S. GOLD, Secretary of the Connecticut State Board of Agriculture.

## WHAT CAN LEGISLATION DO FOR AGRICULTURE?

BY T. S. GOLD OF WEST CORNWALL, CONN.

MR. CHAIRMAN, LADIES AND GENTLEMEN: — I have committed to writing what I have to say to you to-day, that I might not be induced to wander too much, and perhaps weary your patience too long. Otherwise, I should have preferred to have spoken as the ideas came to my mind; but, with the necessity of being brief, I have written the few things I have to say.

There is a great outcry about the depression of agriculture, the decadence of agriculture, and, among the reasons brought forward to account for this state of things, it is charged that legislation operates injuriously to the farmer; that his rights are not duly considered; that he is made to bear an unequal and unjust share in the expenses of the

government, national, State and township, while, in all his efforts to disenthrall himself and assert his rights, he becomes only the tool of the wily politician, who lies in wait to turn all his efforts to secure his just rights, so that, work as hard as he may, he makes little advance, but comes out at the same hole which he entered, with the same leaders or a hungrier set to fatten on his hard-earned products. This feeling is encouraged by a certain class of would-be leaders of agricultural sentiment, so that, from the situation of affairs, I am reminded of the old story by Æsop (by the way, what modern books can take the pace of Æsop's fables, for the entertainment and instruction of young or old), of "Hercules and the carter." We read: "As a clownish fellow was driving his cart along a deep, miry lane, the wheels stuck so fast in the clay that the horses could not draw them out. Upon this, he fell a-bawling and praying to Hercules to come and help him. Hercules, looking down from a cloud, bid him not lie there like an idle rascal as he was, but get up and whip his horses stoutly, and clap his shoulder to the wheel, adding that this was the only way for him to obtain his assistance."

When I was first looking for a title, I met "Legislation for the Farmer," and I said, we want none, — we want no class legislation; we protest against legislation for other classes of men, and shall we ask it for ourselves? and hence shall we say there is no need of legislation for agriculture? Legislation for agriculture means such laws as will favor the highest development of all our agricultural resources, will guard agriculture and the farmer against laws that favor any other industry at the expense of agriculture, that impose upon him more than his due share of the expenses of government in proportion to the benefits he may enjoy, these expenses being executive, legislative, judicial, military, postal, educational, — for roads and care of the poor and dependent classes.

Those who follow agriculture are made up of two great classes: One that engage in it as a life work; the other made up of the broken parts of lives, men who are looking for something else to do, or men broken in mind, body or finances, who resort to farming in their extremity as a means

of support. As agriculture has to take these broken parts of lives, statistics of our courts and charities show to the disadvantage of agriculture. It is not the source legitimately from which our almshouses and penitentiaries are filled. Agriculture is entitled to all the relief it can gain in this direction. Society is bound together by inextricable ties that cannot be broken or dissolved without general loss. The success of manufacturers does make a market for the farmer, who also enjoys benefits of cheaper and better goods, if real and not shoddy. Wise, honest judges, pure, faithful clergy, and skilful physicians are needed by the farmers as much as by any other class, and they should rejoice in the success of those institutions designed for their education. An honest merchant to buy and sell is an essential part of any community; skilled artisans, with trained arms to execute, and educated brains to plan machinery and bring under control the natural powers of mechanics, are a blessing to agriculture. And in squaring accounts with other callings, are they not still more dependent upon agriculture?

Agriculture provides for the world not only the most necessary products but the most perishable, and the most susceptible to bad influences; requiring for their perfection, the nicest care and the most intelligent skill; a forethought not less than that of the builder who constructs a ship. All classes ask for the best products of the garden, the orchard and the dairy. The farmer is expected to pay without haggling the bills of the lawyer and the doctor, and the salary of the clergyman, and for the goods of the merchant. Why should he alone be expected to take what he can get? This is not a matter to be helped by legislation; but let the present growth of cities continue for another decade, at the expense of the country, how can it be otherwise than that the farmer, holding in his hands the daily supply of food, will be acknowledged as master of the situation, as the most important factor in our national life and prosperity? Everything that can be done by legislation for agriculture, is as much or more for the benefit of the rest of the community than that of the farmer; for "the king himself is served of the field."

The farmer can raise better crops, provide better vegetable and animal food, when skill and education give him ability

to use to the best advantage all those powers of nature, which by their subtle influence bring to perfection the golden corn, the rosy butter; that cause the orchards and vineyards of our thousand hills to glow with their luscious harvest.

This is fact, and not fancy. We have to go back but one hundred years in our history, to see how we have grown up and thriven together, — agriculture, manufactures, commerce and mining, — the four material departments of human industry, agriculture the only one upon which all others depend; while the learned professions, so called, and the scientists, are bringing the sheaves of their industry into the common garner.

Now, the point I would make is that we do want laws for agriculture, but we do *not* want laws for farmers that will in any way interfere with the rights of other classes. We demand only what properly belongs to the interests of agriculture in the great body politic of which we are members, and of which interests we should be more cognizant and better informed than other classes; yet not so narrow in our vision as to be able to see only our little hatchet, which we would like to grind, if we can find some other fellow to "turn the grindstone."

It cannot be expected that I should discuss minutely these questions about agricultural legislation, but I would justify all means used by the national or State governments to promote education in agriculture by the way of fairs, institutes, boards of agriculture, agricultural schools and colleges, and experiment stations. These are not alone to educate the farmer and his family, — they are for the whole community. The agricultural schools and colleges draw their pupils from the city as well as the farm; and, while some go to the farm, others go to the shop, and carry with them that knowledge, wherever held, that is to be the means of elevating and blessing the world.

The burning question is now about fraud in dairy products — oleomargarine — and in lard, where cotton-seed oil comes in to extend the product.

It becomes the farmer, knowing the facts, how this fraud interferes with legitimate industry, to publish it, and ask for

legislation in the interest of righteousness; but to ask for legislation because it interferes with the sale of his butter and cheese and lard is not strong ground upon which to stand. These are frauds upon the consumer when sold under any other than their true names; and such fraud should be dealt with the same as any other counterfeit.

So with regard to milk. It is the farmer who best knows the difference between milk from healthy cows, fed on clean pastures and sound grain and hay, drinking the water of pure streams, or fed on distillery refuse in reeking stables, till their carcasses go to the offal yard. Laws to protect the consumer may hit the farmer sometimes; yet, in the interests of a higher and better agriculture, he should sustain them.

We are just now, in my opinion, upon a question of more vital consequence to the community and to agriculture than any other that we have been called to deal with in a legislative way.

Contagious pleuro-pneumonia in cattle was bad enough, but, thanks to the decisive action of Massachusetts, it was speedily stamped out here. A different course in New York and other States allowed it to spread till it threatened to destroy our export cattle traffic; and then the United States department of agriculture, bureau of animal industry, was empowered to stamp it out. After several years of persistent effort, directed by skillful veterinarians, it has been stamped out, and notice is given that the country is free from this plague. This malady was terrific, for it had one element of danger not common to any other then known contagious disease,—that there was no certain time limit to the powers of communicating the malady, even after apparent recovery.

Now we have another bovine disease, — tuberculosis or consumption, — that is more insidious in its approaches; less easily distinguished even by veterinarians, as it may affect different organs; slower in its progress, with strong suspicion, amounting almost to positive proof, that it may be both hereditary and contagious, and communicable to the human subject from the use of milk or otherwise; that has already gained a wide foothold in our herds of cattle. How to deal with this plague is a question requiring much wisdom

and courage. It cannot be stamped out so readily as pleuro-pneumonia. The losses in the gross are much greater than in pleuro-pneumonia, as a very large but uncertain number of animals are suffering from it. It is difficult for the State to control or extirpate it. The farmer of himself never will do it. Suspected and thriftless animals will often rather be sold than submitted to veterinary examination. When we know certainly what we believe as to the dangerous character of this disease, and this knowledge becomes common in the community, not only among farmers but among all, — as consumers of beef and dairy products, — then we shall have a careful inspection, oft repeated, by competent veterinarians, of all neat stock, especially of dairy herds furnishing milk for market. When the farmer knows that the animal is valueless, even dangerous to the health of his herd or family, he will welcome the visit of the inspector, though he may be required to sacrifice an animal that has cost him dear, and that he values highly. The State cannot well provide remuneration. If one State alone undertakes it, this State must establish and maintain a strict quarantine against the introduction of any suspicious animals, or it would soon become an asylum, into which anything of an unthrifty nature would be crowded, with the chance that the State would pay for it, if the case became established tuberculosis. It would also remove from the farmer the strongest incentive against breeding from tuberculous animals, or against neglect in allowing the disease to spread in his herd.

Bear in mind that this time will soon come. The more intelligent farmers are awake to the situation. We hope united action of neighboring States, or concurrent action of the States with the United States bureau of animal industry, may facilitate the work and lighten the burden.

In legislation for agriculture, the question of taxation comes in. Real estate, especially land, is the only property that cannot escape taxation. The stock of the farmer is also visible, and gets into the lists; but how is it with the stock of the manufacturer and the merchant? Personal property has rare facilities for escaping taxation. Again, inherited and accumulated wealth rarely pays its due share of the public

burdens. The General Assembly of Connecticut, Session of 1889, passed an act designed to reach this personal property held in the form of bonds and notes, and secure a small tax therefrom. Any person is allowed to take or send any bond to the State treasurer, and pay a tax of one per cent for five years, or for a longer or shorter period at the same rate. These bonds are registered by the treasurer, and notice attached of the time for which the tax is paid, with amount of the same; and all bonds so endorsed are free from all taxation for the time specified.

How has the law worked? The towns where a greater amount was collected for the town treasuries on these bonds than is now collected by the State on the same class of property, are very few indeed. These exceptional cases were mostly where bonds were held in trust, and could not be concealed. The tax collected on these bonds by the State has so replenished the treasury that no State tax was required last year, with the prospect that the same happy immunity will continue in the future. Now, most of these bonds are held in the richest towns in the State, very few in the poorest. Hence, here personal property is made to pay a share of tax, to the relief of those less able to pay, and whose property cannot be concealed.

In accordance with the provisions of this law, there were registered bonds from Aug. 1, 1889, to July, 1890, $33,654,335, paying a tax of $129,452.06. From July 1, 1890, to Oct. 15, 1890, $21,673,725.76; tax paid, $71,360.12. Now, by means of this tax, and others of a general nature, the towns have been relieved of the State tax; and thus, besides securing some tax from hitherto concealed property, there has resulted some equalization of the State burthens; and the efforts of rich men to live together in certain townships and thus secure low rates of taxation, have to this extent failed of their object.

There is one other feature of taxation which now appears unequal and unjust. The farmer, with a net income of one or two thousand dollars, pays taxes on a capital of ten or twenty thousand dollars; while the salaried clerk or agent receives the same amount, and pays little or nothing. He enjoys the same protection of government, free schools, and

every privilege as a citizen, but carries but little of the burden. How can this difficulty be reached but by a tax on all incomes above a specified sum, say $600 or $1,000, not derived from capital which is of itself taxed?

Then why should not women who are taxed have the right of voting, at least where taxation and expenditure are concerned? A man, a clerk at a salary of $1,000 per annum, may pay no other tax except poll tax; and a woman with a farm yielding an equal annual revenue pays a tax on $20,000, and educates this man's children, and supports him and his family if they become paupers, and still has no voice in controlling expenditures for these purposes, or preventing those causes that produce pauperism and crime, the great burdens upon the public exchequer. If men will not right these wrongs, will they not at least allow the women to do it? Though not a female suffragist, I see the point to which I am led by my own admissions and arguments. My hope and argument is that there is honor and magnanimity enough among the men, love for their mothers, wives and sisters, to zealously defend their rights and regard their wishes, even when not forced to do it by their action at the polls.

The endowment of railroads with large tracts of the public domain, and the homestead acts, causing the rapid settlement of new sections, to the depletion of the old, and the schemes for irrigation by the national government, to fit barren land for cultivation, are all in the interest of speculators; and it is time to call a halt, and see if we are not thus wasting natural resources that belong to posterity, as well as endangering the healthy development of the settled portions of the country.

None of this legislation, as we progress in the enumeration, is for farmers, but for agriculture. The dog law for the protection of sheep is another illustration, and should be so effective in its requirements by reaching all dogs, with a tax upon this luxury so high, as to accomplish the object of protecting sheep, so that the dog nuisance should no longer interfere with the success of this industry.

The farm dog, to keep in check the various vermin that destroy lambs, poultry or crops, and serve as protection to

the family against tramps and burglars, is a useful animal. All others are luxuries, and those who keep them should pay for the privilege, for the protection afforded by the law to these animals when they are outside the premises, and beyond the care of the owner. The apathy of the farmers alone prevents the enactment and execution of laws to abate this nuisance.

Here I wish to remark that the protection or encouragement of any farm industry, be it sheep, dairy, tobacco or any other, is a protection to every other product. If one thousand sheep are kept in place of one hundred cows, there is so much less competition in the dairy. When properly handled, these thousand sheep are such improvers of the pasturage and productive capacity of the lands, that no less cows may be kept, and whatever income they bring to agriculture is a larger interest on the farm value, and the farmer shares his profits with the manufacturer, who gets more, cheaper and better wool, and with the consumer, in which class he belongs, who gets cheaper and better mutton, and cheaper and better cloth, if adulteration with shoddy or flocks is treated by law with the same stringency as it is proposed to treat oleo and other factitious food products, — and why not?

The game laws, with a certain show of learning, a talk about *feræ naturæ* ("wild nature"), seem designed more to favor hunters than to protect game or to favor agriculture. Why should not the owner of land have with it all the privileges of fish, game, wild fruits, etc., without the necessity of inclosing that land and posting it, to keep off intruders? Hunters know, or should know, whether they are on their own land or on that where they are permitted to hunt, or on yours, from whom they will not take the trouble to ask permission for the privilege. From the side of agriculture, why should the farmer's boy be excluded from his method of taking game, that the sportsman may overrun his fields, scare his cattle and sheep, and perchance shoot them, or more often allow them to wander from their inclosures by a reckless disregard of his rights by opening bars or destroying fences?

The right to take game should be vested in the owner of

the land, in spite of this old legal fiction. Thus some additional value would be given to our wild lands, and those who wished to enjoy the sport of hunting could pay for it. Agriculture, with a fair acknowledgment of her rights, would never prohibit others from sharing these privileges; though some farmers might object to the hunters in their groves, preferring to see the gambols of the squirrel and to hear the drum of the partridge and the note of the quail and the song of the lark to any consideration the hunter might offer, — and why not?

You see by this time the breadth of my subject, — too broad for treatment in a single half hour, except by suggestion.

Why do we need legislation for agriculture *now*, more than formerly? Because there are new laws favoring other industries. Other industries, unless controlled, will crowd on the rights of agriculture. Witness flowage laws, etc.

Modern means of transportation, methods of trade and manufactures, need control, that the rights of the whole community may be regarded and sustained. The increasing transportation of live stock favors the spread of contagious diseases; of hay and grain, the spread of weeds. And here let me remark that it is suggested to protect agriculture against these latter by prohibiting the sale of hay or grass seed containing Canada thistle and various other weeds. Our experiment stations are doing a good work to help in that direction. One station (Michigan) has sent out, with its bulletin on the subject, samples of clover seed infected with seeds of the narrow-leaf plantain, a harmless weed, only as it crowds out better growth, and as it seeds abundantly, doubly deteriorates any clover seed of which it forms a part.

But in closing I take up again the illustration of Hercules and the carter. Agriculture must not expect any great revival from any special legislation. Tariff or free trade it can stand and prosper, taxation can be adjusted, transportation privileges for rural districts secured, frauds in food can be prevented, the health of farm stock can be guarded, education for the farm can be encouraged, beginning with the district school; but, after all, these are but feeble

helps to agriculture. We must not rely upon Hercules to help us, but rather hold that position for agriculture that we claim for it, by our physical, intellectual and moral strength, as its living illustration as, in the language of Washington, "The most healthful, most useful and most noble employment of man."

Mr. Appleton. I would like to move that a most sincere and hearty vote of thanks be extended to the speaker of this morning and the speaker of this afternoon, for the admirable way in which they have entertained and instructed us.

The motion was seconded, and unanimously carried.

Mr. P. M. Harwood of Barre. I have been very much interested in the discourse this afternoon, and was especially struck with that part which alluded to the fact that legislation should be in the interest of agriculture, rather than special class legislation. It was during one of the first meetings of this Board which I ever attended that the matter of inspection of fertilizers was brought up; and I think it was largely due to the influence brought to bear upon the Legislature by this Board that a law was passed requiring State inspection of fertilizers, and that the manufacturers of fertilizers should state what they sell, and sell what they state. Now, this was legislation in the interest of agriculture. At the annual meeting of the Board last spring the Secretary asked me to prepare a paper upon grasses, to be read before some of the institutes; and, in looking up that subject and studying it, my attention was especially called to the fact that we needed an inspection of seeds. I believe that we need an inspector of seeds in Massachusetts just as much as we need an inspector of fertilizers; and I do not know but, as one gentleman says at my right, more. I therefore think it would be perhaps well for this meeting to express an opinion upon that subject; and, as my attention was again called to the matter by this discourse, I have just written a resolution which I will offer: —

*Resolved*, That, in the judgment of this meeting, a law should be passed by our State Legislature, requiring that all seeds sold in this State shall be sold under a guarantee that they possess a certain

per cent of purity and germinating power. Also, that a State inspector of seeds should be appointed to carry out the law, to the end that all dealers in seeds shall be required to state what they sell, and sell what they state.

I move you, sir, the passage of this resolution.

Mr. Appleton. This subject has been considered in England by the chief agricultural society there, and, if I remember rightly, the law has certain provisions for the protection of farmers. It requires that there shall be a certain per cent of purity in their seed; they recognize the impossibility of getting them wholly pure, and the botanists of the Royal Agricultural Society inspect all seeds that are sold under a guarantee, and give information at a fixed and very reasonable rate to all agriculturists.

Mr. Moore of Worcester. Such a law would be first rate if it could be carried out, but it would shut off the farmers. Suppose I should bring in a bushel of beans, and want to sell them, and suppose that I have got to guarantee fifty per cent of germinating power, — would I or would any person undertake to give such a guarantee? Perhaps under favorable circumstances fifty per cent would germinate; perhaps under other circumstances a much smaller per cent would germinate.

Mr. Sears of Worcester. I bought the past year a quantity of what I supposed to be grass seed, and found that I had bought a large quantity of wild carrot seed. It was scattered over three acres, and I had to pull it all out. I won't have it in my field. If you go down to the Old Colony you will find fields where there is nothing but wild carrot to be seen, and if we introduce it here it will spread so rapidly that we shall soon find no grass growing. We find that the ox-eyed daisy is spreading in the same way, and so of other seeds. I have bought seed purporting to be clover seed, that contained anything but clover. Of course we can more readily detect adulteration in the case of larger seed; but I have found that the germinating qualities varied exceedingly. As I have been somewhat in the garden business, I have had a chance to test a good many of these things; and I think it would be very judicious to have something in the way of

legal restrictions that would enable us to get a little nearer to what we buy and pay for.

Mr. Howe of Oxford. I wish to speak about the seeds of weeds in particular. We have for some years bought and sold seeds. We have paid an extra price for them, because we wanted to give our patrons clean seed, free from weeds. We have sold them to our good neighbors, and pretty soon they were on top of us for selling them wild turnip seed. I think it is time we were able to get what we buy.

Mr. J. H. Hale of Connecticut. I think this is a matter of very great importance. I can see very readily how you may pass such a law, and that it may be enforced as far as the purity of seeds is concerned: I think a certain inspection could be given through the officers of your experiment station, that would guarantee a certain per cent of purity that would satisfy the consumer. But the question of the germinating power, if it is left to each individual gardener or planter, would be very uncertain. Almost any gardener or farmer knows that oftentimes he has bought garden seed, sowed it on a certain part of his farm at a certain season of the year, under certain conditions, and perhaps ninety-nine or a hundred per cent of that seed has germinated. Then he has sown some of the seed from the same package a week or two later, and has had almost a total failure. The question of the germinating power of seed should not be left in the hands of the gardener or planter. The seed should be tested, and a certificate given from some State authority. Then, again, there are great variations of seed grown on one kind of soil and planted on another soil. A certain seed grown in California might have a very high germinating power when sown on our soil here, and fail to some extent in other localities. It is a difficult question to handle. I believe we have many honest seedsmen who are aiming to have grown for them the best possible seed, and that they handle it in the best manner, and deal honestly. Then, again, they have rivals in business who do not hesitate to buy the cheapest seed that they can find, mix a little good seed with it, and then sell the whole as good seed. Such a law as the one proposed would protect the honest seedsmen

just as much as it would protect the farmer. It is right in the line of work indicated by the paper given to us this afternoon. It is of interest to agriculture, it is of interest to every honest man dealing in seed, and it is of interest to every planter. I think it would be a good thing for the State of Massachusetts to be the first State in the Union to strike out on that line. It is coming, sooner or later. You might as well begin in 1891 as to put it off till later.

Professor ROBERTS. I feel that probably this is a good entering wedge; but I liked the word of the last speaker on the stage, when he said we should have laws "in the interest of righteousness." This only strikes at one little bit of fraud, and so it is not broad enough. I do not wish to throw cold water by any means upon this resolution; but to try to administer a law in a great State like this simply on one little interest, with all the expensive machinery, will be found very difficult. What we want is a general law, not for Massachusetts, but for the United States, "in the interest of righteousness," that all things shall be what they are marked. Now, in the State of New York we run against this constitutional provision, that the Legislature can make no law governing trade of any kind or prohibiting adulteration of any kind except that adulteration can be proven to be inimical to the health of the people. We cannot touch such a thing in our State, we cannot even control commercial fertilizers; and it is quite time that we as farmers, who have now got a little touch of the rein which we ought to have gotten hold of long ago, and learned to drive our own team, — it is quite time, it seems to me, that we broaden out, and say there is such a thing as eternal justice, and that is all we demand, — not one cent for the farmer, but eternal justice in taxation and everything else, — and that we will spend our last breath and our last dollar to secure it. You New Englanders are used to that sort of work, are you not? Your ancestors fought for eternal justice. Are you the degenerate sons of noble sires? Eternal justice! It does not matter whether you are a farmer, or sell peanuts on the corner. Let us stop this age of everlasting fraud, and the only people that can stop that is the farming community. It will never be stopped by the politician, it will never be stopped

by the man who sells you shoddy cloth. If it is ever done, it has got to be done in New England by the farmer.

Mr. Gaffney of Worcester. I can see how this thing may be worked in reference to oats or grass seed; but where is the inspector who can take onion and turnip and cabbage seed, and say that that seed is this and that seed is the other? He may say it is onion seed, but what advantage is it going to be to the gardener to have a law of that kind? There is no seedsman in this country who will sell seed under a written guarantee. Every seed package that you buy at the present time has printed on it in plain letters: "We do not guarantee a crop, and if these seeds are not taken under that condition they must be returned immediately." Now, there might be an inspector who should look over the seed; but, as far as obliging the dealers to guarantee the seed, that is practically impossible.

Mr. Edson of Barnstable. I think we are a little hasty about these laws. We farmers do not like to pay any more for our seeds than we are obliged to. What seedsman is going to guarantee all his seed without compensation? If such a law is passed, shall we not have to pay five times what we are paying to-day for our seed? If such a law is passed and enforced, it will drive out a large part of the merchants who are selling seed, and those who are left in the business will put up the price to cover all damages, and we will have to pay it.

Mr. Record of Worcester. I would like to say a word in reference to the point the last gentleman made. I have for the last fifteen or sixteen years been in the market gardening business, and have learned to value good seed so highly that when I can get the very best seed possible I would not even take a gift of poor seed, and when I can get just what I want, the cost does not amount to a snap of the finger. I think we can afford to pay the price that is necessary to get the very best seed. It will be for our interest.

Mr. Brown of Westborough. In my opinion, something ought to be done in the way of legislation on this subject. For many years I raised seeds for the Boston dealers, and I remember once selling quite a quantity of seed to a dealer, and he remarked, after he had completed the purchase,

"This seed I shall mix with the old seed, so as to have a certain percentage of germinating seed in it, but it will go as new seed." It is well known that onion seed loses its germinating quality in four years, and even in three years under unfavorable circumstances, and many seeds are good for nothing after two years; but those seeds are mixed by unscrupulous dealers with new, and sold as new seed to the average gardener. He is in a measure satisfied; he expects a good deal will not come up, and he makes no complaint. This proposed legislation would prevent unscrupulous dealers from keeping seed until it is worthless, and then selling it as new seed.

The CHAIRMAN. When the question of fertilizers was brought to the attention of the farmers of Massachusetts, we met the very same objections that we meet here to-day as to the increased cost and the impossibility of getting inspection; but we found it a very simple thing to obtain what we asked for, and the farmers of Massachusetts were saved thousands of dollars which had been thrown away before. The effect of the law was to drive out worthless imitations, with hardly an effort on the part of the farmers of Massachusetts. Such a law will be a check upon the dealer from the time it is passed. Certainly there are but few of us who have not been taken in by poor seed; and it has taken us years to eradicate from our farms the weeds and foul stuff that such seed has brought us. I do not know whether the resolution will cover the point, but it seems to me that it is a step in the right direction. I hope we shall take action in the matter.

Mr. CUSHMAN. I would like to know to what extent it is intended that this proposed law should be carried. No law is of any practical effect, as a rule, unless there is some penalty attached to it. There are some men, especially those engaged in market gardening, who would be glad to pay largely if they could know that their seed had a guarantee from some official in whom they had confidence; there are others who perhaps would not care to go to that expense. Again, it might be unfortunate in its operation. For instance: in my own case, I sell a limited quantity of seed corn every year; I sell it in good faith; it is just such

corn as I plant. I should hardly want to go to the expense of having my whole crop inspected, or even my seed corn. But I can conceive how this law might be of great benefit. Those dealers who sell large quantities of seed, and are willing to go to the expense, might have their seed inspected; and those of us who are willing to pay for the trouble and expense of that inspection would know where to go to secure seed, we should know when we purchased that seed that it had the germinating power in it. The dealer in seed would be responsible to that extent, but he would not be responsible for the result if you or I planted that seed, in perfect ignorance of the nature of the plant, where it would be impossible for it to germinate. Now, I suppose that that is the extent of the intention of the resolution. If it be so, I think we ought cheerfully to support it.

Secretary SESSIONS. Allow me just one word. I suppose our experiment stations are equipped with facilities for proving the power of germination in seeds. We are not framing a law here, gentlemen. We might take ever so much pains, and fix up a law just exactly as we want it, with suitable penalties and with necessary provisions for its enforcement; but it would have to go before a committee of the Legislature, and be dissected there; and then it must go into one branch and stand the fire of opposition there, and then into the other branch, and pass the same ordeal. Then, if it passes both branches of the Legislature, it is looked over with reference to its constitutionality by the Governor. We simply propose to recommend to the State of Massachusetts, by the passage of this resolution, the enactment of such a law; and it strikes me, if the resolution accords with your idea, we shall accomplish about all we want to do by its passage. I bought some seed oats two years ago, very fine-looking ones indeed, of a well-known seed dealer. I sowed them, and not one in ten came up. I wondered what was the trouble. The dealer being a friend of mine, I went to him and stated the case. He said: "I bought a car-load of oats that came from the West; I thought they were very nice oats, and winnowed them over and sold them for seed. I suppose those oats had heated

in an elevator, and the germinating power was destroyed." That is one sort of trouble we want to avoid.

Mr. Kinney of Worcester. I think it would give better satisfaction, and would be more to the point, if we should simply vote that we approve of having an inspection of seeds. I think that would be a grand thing; but when we ask seedsmen to sell on a guarantee, it is a very hard thing to do. Many seeds are put into the ground at a bad time, when the ground is in a bad condition; and the fact that those seeds had been in a greenhouse under the most favorable circumstances, and made a good start, would be no proof that they would do well under other circumstances. There would be a great many objections to such a law as is proposed. But, if we called for a law authorizing the appointment of a State inspector of seeds, then the seedsmen and the farmers could meet together, and arrange the details. I think that might be very desirable.

Mr. Stockwell. The idea of an inspection of seeds I suppose is that the seeds should be given a trial in which their germinating power should be properly and thoroughly tested under favorable circumstances. It is not for every farmer to do this. The farmer sends his seed to the inspector just as you send your fertilizer to the fertilizer inspector, and there the seed will be tested, and that test will be the dealer's commendation or condemnation. It is a very simple thing. All fertilizers are inspected and sold under a guarantee, and the State inspector sends agents about, to take fair samples of fertilizers; they are analyzed, and then a certificate of that analysis is given to the dealer. Some arrangement of this kind could be made with regard to seeds.

Mr. Bill of Paxton. I came in a little late, perhaps, to grasp the whole situation; but this question of the inspection of seed is really important. It has been said that that people is the best governed who are least governed. I think that is true; and it is desirable to have as few commissions in the Commonwealth as possible; but we can stand one more in the way of an inspector of seeds. If the resolution was confined to the one article of grass seed, if we could have an inspection in this Commonwealth of that seed alone, it would be of immense value to the farmers of

this State. It is not long ago that I ordered some oats with the purpose of using part of them for feed and part for seed; and I was surprised to find, when I opened the bag, that there was a large percentage of Canada thistle seed. Now, if that seed had got into my ground, my whole farm would have been ruined, or at least it would have taken a long time to eradicate the Canada thistle. My case is only an illustration of many others. The inspection of grass seed alone would be worth all that such a commission would cost.

The question was then put, and the resolution was adopted.

The CHAIRMAN. Gentlemen, you are now entitled to ask any questions of the lecturer.

Mr. CUSHMAN. I was particularly interested in the paper read this afternoon. Many practical points were brought out, but none more practical than the matter of taxation. It is well known that considerable attention was given to it last winter in our Legislature. We are honored this afternoon with the presence of the chairman of the committee on taxation on the part of the House in the last Legislature, from whom I hope to hear in the course of this discussion. It seems to me that we as farmers suffer as much injustice in the matter of taxation as any. It was brought out last winter before the committee that from one-half to one-third of the personal property of the Commonwealth escapes taxation in one way and another. As it was justly remarked in the paper, the farmer's property as a whole is visible to the tax-gatherer; his houses, his lands and his stock are all in sight, and are taxed not only for their full value, but in many cases far in excess of their market value. The lecturer this afternoon touched upon the justice of those receiving salaries paying in proportion to the income of the farmer. The moment we attempt to grapple with such a question as that, innumerable obstacles arise. I thought that perhaps the essayist of this afternoon had given this matter mature deliberation, and would be able to give us more light than he did in his able paper. I have thought more or less upon that question, and I presume you all have; and I can hardly see, if we tax a man on the first of

May who has been receiving about twenty-five hundred dollars a year salary and living right up to his income, spending it from month to month, — I hardly see, I say, how we shall collect that tax in the fall, when he has spent every dollar of his income. I should be glad if the lecturer would tell us how we shall collect the tax of a salaried man who has already spent his income.

Mr. GOLD. I plead off from going into these particulars. I tried to present in my lecture some general considerations that should set us thinking, and by which the men who are familiar with legislative matters should work out a reformation upon some of these points. But, as for knowing how to get over all these knotty questions to which Mr. Cushman alludes, I confess that, while I have met them, I am very much in the dark still with regard to how the thing is to be accomplished. But, when we know that a work of this kind is required, after it becomes apparent to the community, I believe a way will be opened to us to accomplish our purpose We shall not go on eternally under the present system.

Mr. EDSON of Barnstable. I have been very much instructed and entertained with the essay of the afternoon, and, when the lecturer touched upon the question of taxation, I was all ears, for it has been a hobby of mine for several years. He stated that the Connecticut law had recently been changed, and that the taxation upon notes and bonds and that kind of property that is easily hidden from the eyes of the assessors had been fixed at one per cent for five years. I want to ask the gentleman from Connecticut what the law was with regard to the taxation of that kind of property in that State before this new law was passed. If it was not taxable before, the State has done a good thing. If it was taxable before, what has she done? She has compromised with thieves. That is all there is to it. Where before they would have got one per cent a year, they have said to those people, "We know you are rascals, we cannot trust you; but, if you will be one-fifth part honest, we will let you off." I do not know that the law taxed that kind of property in Connecticut before. I would like to know whether that was the case, or not.

Mr. Gold. The law taxed it, but there was a habit of evading the law. It was a habit that people got into, as the old farmer said with regard to a kicking cow that he sold. When the man who bought her complained of his purchase, the old farmer said, "It must be a habit she has got, — a habit she has got."

Mr. Edson. Then the habit of the people of Connecticut is to evade taxation. Let us look at it in our own Commonwealth. All of that kind of property is taxable here. A ten-thousand-dollar bond is just as much taxable as a ten-thousand-dollar farm. Is it taxed? Not at all, — not in one case in fifty. The valuation of this Commonwealth is about two billions. Is there a man within the sound of my voice who does not know that the personal property of the Commonwealth of Massachusetts is three or four times the amount of the real estate? That everybody acknowledges. Why, it appears that $55,000,000 worth of property that had not been taxed was brought out in Connecticut, because its owners got off by paying one-fifth of what they ought to pay. Now, we ought to have a law in this Commonwealth that shall uncover this personal property. The farmers of this good old Commonwealth of Massachusetts are paying the tax of the capitalists. Their tax is more than double what it would be if we could get hold of the personal property. It is said we cannot get hold of it. I know better. I have been an assessor in the town of Barnstable for seven years. The law in this Commonwealth is all right and proper. What does it say? It says that the assessors *shall* — it does not say, "You *may*," or "It is best for you to do so" — but "You *shall* put every man under oath in regard to his personal property." Do they do it? We had over forty assessors before our committee on taxation last winter on this very question. Not one in ten of them put people under oath. It is a very delicate thing for an assessor to go to one man and say, "I am going to put you under oath in regard to your personal property." "Why," says the man, "do you suspect me to be a rascal?" That is the first question. That law is a dead letter on our statute book. I attempted, as a member of the committee on taxation, to put some life into that law. I proposed to pass a law that would

impose a fine of twenty-five dollars upon an assessor in every case where he neglected to put a man under oath in regard to his personal property. Out of forty-two assessors who came before that committee, forty of them were in favor of that law. Why? Because they are perfectly willing to do it, if they can do it without any risk to themselves. They are all looking for re-election, and they know that if they should attempt to carry out the law when it has been ignored so long they would not be re-elected. Put that law in force, and I will guarantee that the taxes of the farmers would be reduced one-third the very first year. Two billions of property for taxation in this Commonwealth. Five hundred millions of that is personal property. Just think of it! One-quarter only, when we all know that the personal property is four times the amount of real estate in this State. The Commonwealth of Massachusetts is one of the wealthiest States in this Union We hold the bonds of railroads all over the country, we hold mortgages on property all over the country, and yet we pay but a very small personal tax. Let me tell you one thing, brother farmers: it is coming to this, that we have either got to get hold of this personal property and tax it, or they will put the whole taxation upon real estate. They came up before the legislative committee, and said, "We are only taxing about a quarter part of the personal property; why not drop it entirely, and put the whole tax upon real estate?" It will come to that unless there is a law passed that will get hold of this personal property. I know that it can be got hold of, from my own experience as an assessor in the town of Barnstable. When I was elected, I determined that the law should be enforced in that town; and in less than five years I increased the valuation of personal property from $800,000 to over $1,600,000. And what was the result? It reduced the taxation from $12.50 to $8.30 on $1,000. That was by merely enforcing the law. I had some pretty warm work, I will admit, but yet they kept on electing me.

Mr. Cushman. What do you think would be the effect, if you should have a rigid enforcement of the law, in driving personal property out of the Commonwealth?

Mr. Edson. Supposing a man is living in the Common-

wealth who is worth a million dollars, and it is all invested in Western railroads and Western mortgages. He does not own any real estate; he pays no tax; he takes that interest money as it comes in, and reinvests it in Western mortgages and Western railroads. What benefit is he to the Commonwealth? That is just the kind of men we should drive out. Such a man is no benefit to this Commonwealth by simply living here, standing still, and accumulating property that pays no tax. We should not drive out any honest capital that is paying an honest tax. It is no argument against the proposed law, to say such a man is going to leave the State because he has got to be honest. I believe in honesty, I believe in righteousness. I believe that if a man has got $100,000 in personal property, and is receiving the benefit of the laws of Massachusetts, he should pay the same proportion of the taxation as though he had $100,000 in real estate. One man came before the committee of the Legislature, and said, "We want you to pass a law that will put the whole tax upon land, exempting all personal property." I could bring my own town up to show the absurdity of that thing. Our personal property and our real estate are just equal. Our tax is ten dollars per thousand. You take off the personal property, and you make the taxation twenty dollars a thousand to the farmer. Then you take off the buildings, which he called personal property, which are just about equal to the value of the land in the town of Barnstable, and you make the farmers' tax forty dollars a thousand. I told him, if he wanted to annihilate every farmer, drive him out of the business in the Commonwealth of Massachusetts, pass that law. But, unless we stir in this matter, and enact some law that will get hold of personal property, just so sure as I stand here a law will be passed exempting personal property from taxation.

Secretary SESSIONS. I want to say just one word, lest a wrong impression should be created by this discussion. It is, I suppose, well known to you that all bank stock and all stock of corporations in Massachusetts is taxed, and all savings bank deposits are taxed to a certain extent. So that the personal property that escapes taxation is not of this character. It is not personal property that is invested

in shares in manufacturing or railroad corporations within the State. Every man who owns a share in the Middlesex corporation at Lowell, or any other corporation that is manufacturing in this Commonwealth, is taxed to the full value of that share. So every single share of bank stock of these Worcester banks is taxed at the rate of taxation here in Worcester. The property that escapes taxation is other than that invested in business here in this State. It is not the property that is adding to the industries and business of our State that escapes taxation; it is the property that is used to juggle with, that is invested in foreign mortgages and foreign corporations (outside the State, I mean), and money that is used for speculative purposes. That is the kind of property that escapes taxation.

Mr. Hale. This is a very important matter, and I was much interested in what my friend Mr. Edson has said. But we all know enough of human nature to know that a man who will lie will lie just about as quick under oath as he will when not under oath. A few men will be frightened at the idea of taking an oath. They are liars, but they are not utterly reckless liars, and they will feel the force of an oath; but the average tax liar will lie anyway. This may be pretty strong language, but I think the fact warrants it.

Now, this law which Mr. Gold has told you about in Connecticut, which last year drew out such a large sum, was a compromise with perjury on our part. I think the best people of Connecticut felt ashamed of it, but it was the best thing we could do. We have by that law pulled those sneaks up through the hole. I think by-and-by the farmers will plug up the hole.

I have studied the question of taxation from a farmer's standpoint. I have looked at it in all sorts of lights. I have studied poor, weak human nature; and I find that, while you can touch some men by an appeal to their honesty, you cannot touch them all. When you touch a man in his pocket, you have got away down below his heart. It seems to me a law might be passed that would compel every property owner on a certain day or month in the year to go before an assessor and make a record of every dollar's worth of property he possesses, and make oath to it. The assessor

can strike out whatever is non-taxable, and the rest is left. Then I would have a law which would forfeit any property not reported, one-half of it to go to the State, and the other half to the man who ferreted it out. That is my idea of the only law that can ever bring these men out. God speed the day when it comes!

Mr. SHAW. After five years' experience as an assessor, I have come to the conclusion that the only way by which we can procure the justice for which we ask is to make the people give in a list of all their property, wherever it may be located. The assessors are the ones to judge whether it is taxable, or not, not the person who has it. The gentleman from Connecticut has, I think, hit that nail directly on the head.

Mr. PARKER of Holden. One inconsistency in our law, as I understand it, is that the money loaned upon mortgages in Massachusetts is not taxed. I have found by a little investigation that about two-fifths of the property in Massachusetts escapes taxation in this way. Now, it appears to me, as a person who pays taxes upon property that is all visible, and expects to pay a fair per cent with his neighbors, that there is no reason why a neighbor of mine who may have $100,000 invested in mortgages upon property that is ample security should pay no tax. If he has a note secured by personal property, floating property perhaps, he is liable to a tax upon that; but just as soon as the money is invested in something that is tangible, where the income is sure, he goes free, he pays no tax; and those of us who pay taxes maintain his children at school, and if he should happen to come to want, we maintain him in the poor-house. It seems to me that this is a question in which farmers are very much interested, and this is the place to agitate the question and have the influence of the State Board of Agriculture brought to bear upon the members of the Legislature. I know you are handicapped to start with. There are more people in the Legislature who loan money on mortgages than there are who borrow, and for that reason you will find it difficult to pass a law of that kind. It seems to me there is no remedy except to send men to the Legislature who do not belong to that class. Then perhaps you would get

honest legislation. I wish that a resolution might be brought forward and backed up by the farmers here, that shall look to securing the passage of a law providing that all property that is invested in mortgages in Massachusetts shall be taxed like other property.

Mr. F. J. Kinney of Worcester. It is a matter of fact, — it is not guess-work, — that property rules the nation. Now, supposing that the man who loans money to a poor man on a mortgage has to pay the taxes on it; the poor man will have to pay them, because his rate of interest will be increased until the rich man is secured. In very many ways, and unknown to themselves, farmers are gathering about themselves clouds that it will be very hard to escape from, and that is one of them.

Dr. Twitchell. I am much interested in the question now under discussion. We are working upon it down in the State of Maine. One gentleman has said, "Send a class of men to the Legislature who will be true to your interests." I say, "Get behind the men you have now in the Legislature." There is the work for the farmers in your State and in my State to do. We have got to get behind our legislators, and make them feel our power; and, doing that, we shall bring about results. The trouble in the State of Maine is, that we cannot arouse the farmers to come up before the committees of the Legislature, and there stand together for results. They ask the grange, they ask the Board of Agriculture, to do this and to do that for them. We turn round and say to them, "Gentlemen, if you want this thing done, go up there yourselves, unite your influence with ours, and we will give you results."

Professor Roberts. Mr. Chairman, it seems to me that the fault lies with ourselves entirely. We have submitted to this wrong and oppression, because it was easy for us to get a living and pay the taxes to boot. The arm of the law can reach every dollar of property. There is no trouble about it. Uncle Sam manages to reach everything that is in your trunk when you land in New York; and, if you undertake to lie out of it, he will take your property and confiscate it; he will take your trunk, and he will take you. It is idle for any man to get up here or elsewhere and say

that the law cannot reach all his property, and that, because a man is a liar and a rogue, you must let him go and call him an honest man. We have laws against horse stealing. We cannot always execute them. Once in a while a fellow gets away with a horse, but as a general thing we catch the horse thief. As a general rule our horses are perfectly safe in our stables. We go to bed and rest easily because justice is abroad in the land; the strong arm of the law stands there at our stable door with the sheriff to protect our property. And shall we, as farmers, as men, as citizens of a great republic, quietly pass a few little wishy-washy resolutions, and then go up and vote the straight ticket?

It is not class legislation. We do not want legislation for the farmer, we do not want legislation for the Republican, we do not want it for the Democrat, we do not want it for the Mugwump. Let us rise to some sort of dignity as citizens of this great Commonwealth and this great nation, and say, "Gentlemen, eternal justice, if we have to get it with the aid of the sheriff and the hangman." We have, in our haste, in our anxiety to get wealth, in our newness, in our want of knowledge of how to govern, — for we lack a good deal in that yet, — we have gone on and simply ignored the wrongs that are easily corrected if we only set our foot down. And I want to repeat again, that the people who are to begin this work are the yeomanry of this country, because in the yeomanry reside more virtue and more democracy than in any other class of people. We are not naturally any better, but our opportunities are better; our environment has simply made us a little better. The reason why we are a little better than the average saloon-keeper is because we went into farming instead of liquor selling.

Now, I appeal to the able essayist of the afternoon to know what is the trouble. I go back for knowledge. We find that on the river Nile they had the science of irrigation developed and in practice thousands and thousands of years before ever we thought of it on the western plains. So there is some knowledge lying behind us that is well worthy our careful attention. Joseph went up to Bethlehem to be taxed. Have we found any better way than to go up to the city or the town, and give in an honest schedule of our property,

instead of setting men running around the country after us? Is not that fair, Mr. Gold?

Mr. Gold. It appears to be.

Professor Roberts. A man who does not do his duty as an American citizen should be debarred from voting. He has no right to vote in this country if he does not do his duty as a citizen. No man who is not a good citizen has a moral right to vote. Cut him off, and assess him so that it will bring him next year to a realizing sense of his duty as an American citizen. If he hides his property, confiscate it, just the same as you confiscate the contents of my trunk that I bring over from Germany and am trying to run through the custom house without paying the duty, thus breaking the laws of my country.

It does not matter whom you send up to the Legislature. That is not it. It is the power behind the man that makes the man do the work. Say to these gentlemen whom you send to the Legislature, "Thou shalt," and "Thou shalt not," and it will be so. It seems to me that the time has gone by for talking. We know, — we do not guess, as we do in many problems, — we *know* that every man who owns real estate is paying at least three dollars in taxes where he ought to be paying one, and in many cases five or six dollars. I am talking right against my own interest, gentlemen, to the tune of fifty dollars probably in taxes every year. I am not afraid of the truth, and I say the time has passed for milk-and-water resolutions. The time has come for you to say, "Thou shalt make a just law for taxation, and every dollar of value in this Commonwealth and in the United States shall pay its fair proportion of the expense of watching over it and caring for it." Is not that justice? A large part of the personal property costs ordinarily two or three times as much to watch as the real. We will give the owners of that personal property that advantage; but the eternal principle is that every hundred cents of real value, at a fair valuation, shall pay its true and right proportion of the expense of watching over that dollar. Now, there is nothing wrong in that, and we can have it before next year's snow flies if we just stand together and say, "Thou shalt! We will lift every one of you out of your chairs, from Governor

clear down to assessor, it does not matter whether you are a Democrat, a Republican or a Mugwump, but we will have justice." Let us lose sight of partisanship for a time, and say, "We believe in eternal justice, and give us justice or out you go."

Mr. Edson. I should be very glad to have a law such as the gentleman advocates, but can we get it? That is the question.

Professor Roberts. Yes.

Mr. Edson. I do not know whether the gentleman has ever been in the Legislature, or not; but, if he has been, he must know something of the difficulties in the way of securing the enactment of such a law. I fought hard last winter in our Legislature merely to procure an enactment that should say that the law already on the statute book should be enforced, and what was the result? Forty votes, out of two hundred and forty, in favor of it, — that was all. The other two hundred had personal property that they did not intend to pay any tax upon. There is where the difficulty came, and there is exactly where you will find it will come every time. Look at the injustice of the thing. A young man moved into a small town in this State; his father and uncle had died and left him a great deal of property, and he had made a great deal of property himself. When he came down to that town the assessors asked him, as they usually do, "What shall we tax you for personal property?" He thought $300 would be about right. So they assessed him that amount, and for fifteen years he paid a tax of $300. He died, and his property went to probate. The next year his estate was taxed $2,300. The result of getting hold of that $2,000 was to put the taxation of that town down from $10.00 to $8.50 per thousand. Now, I contend that every widow and orphan in that town worth $1,000 paid $1.50 a year for fifteen years into that capitalist's pocket. He might just as well have gone into the chicken houses of those widows and orphans, and stolen $1.50 worth of their chickens. It would have been more honorable to have done it than to do what he did. I brought that case up before the committee on taxation. I am going there again this winter, and shall try it again; but I have no idea I shall be

successful unless you farmers will come before the committee and plead your own case. We had committee hearings day after day for months, and no farmers came there to advocate their own cause. The assessors were there, and, as I said, forty out of forty-two were in favor of putting this penalty upon assessors if they did not do their duty. Why were they in favor of it? Because it would take the odium off from them, and put it on the law. It is very easy, if there is a penalty attached to the neglect of this duty, to put the law in force. Now, if we can get a law on the statute book that will take twenty-five dollars from an assessor every time he omits to put a man under oath, we shall be able to reach all this personal property. The gentleman (Mr. Hale) says that a man who will lie will take a false oath. It is not so. I tell you that when a man comes up and takes an oath before Almighty God he feels the responsibility. It is only the most abandoned liars who will take a false oath. Very few men who will evade taxation, who will prevaricate and equivocate in making their returns, will take a false oath. Now, if the farmers will only come up this winter when we have this matter before the committee, or send their delegations there and give us some encouragement, I think we can get the bill through.

Mr. Bill of Paxton. I have taken a great deal of interest in the tax question, and I believe you have got to proceed in some radical way. I think the plan suggested by the gentleman from Connecticut (Mr. Hale) would meet the case. I believe that the farmers are paying a larger share of the taxes of this State than they ought to. You have heard a good deal about abandoned farms. If this thing goes on much longer, more farms will be abandoned and there will be more abandoned farming. Farmers are leaving the State already, and farm lands are cheaper in Massachusetts, leaving out those within a certain radius of our cities, than they are anywhere on the face of the continent. The western railroad companies are holding large tracts of land higher than they can be bought for in Worcester County. Farms with their buildings can be bought for five or ten dollars an acre in this county to-day, and it is so all over the Commonwealth. Now, I say if

taxation is not distributed more equally and justly, there will be more abandoned farms than we have now.

But to sum up and crystallize the sense of the meeting, to give it some point, I would move that this meeting here and now appoint a committee of five, whose business it shall be to appear before the committee on taxation of the next Legislature, and present the case, and likewise invite every farmer to go with them before that committee, and push things. This is a world of push and energy, and those who push hardest and are most persistent accomplish most. It is time the farmers did some energetic pushing. You may talk here until doomsday, and if you take no action you will accomplish nothing. You say that it depends upon the Secretary of the State Board or upon some other official, and the farmers' duties are discharged in that way. Are they? I think not. I think the appointment of such a committee is a proper method of action, and would so move, and I would ask the chairman not to appoint me upon that committee.

Mr. Eaton. There is one phase of this subject of taxation that has not been touched upon, which is of great interest to the farmers especially; that is, the matter of taxation for the support of schools. We know that the education of our children throughout the State is of just as much interest to one man as it is to another, but the inequalities of the tax for the support of schools are great. That is, the tax rate needed to raise five dollars per scholar in some of the country towns is four times what would be necessary to raise the same sum per scholar in Boston. Now, I say that the State Board should use their influence with the Legislature to levy a State tax for the support of the schools in a gross sum, and then let the towns draw from that amount a sum in proportion to the number of scholars they have to educate, in that way equalizing the tax all over the State for the education of our children. By doing that, many of the poor country towns would draw from the State treasury a sum greater than that which they pay in.

The Chairman. Will Mr. Bill of Paxton please repeat the resolution which he offered?

Mr. Bill. I offered it in the form of a motion. In order to bring the matter to a head, and have some results come

from this discussion, I move that the Chair, in conference with the Secretary of the State Board, appoint a committee from this meeting, to consist of five members, to present this question to the committee on taxation at the coming session of the Legislature, and invite as many farmers to appear before the committee as possible.

The motion was put, and unanimously carried.

The CHAIRMAN. I appoint, with the approval of the Secretary, as the committee, Hon. E. B. Lynde of West Brookfield, N. W. Shaw of North Raynham, J. P. Eaton of Auburn, J. H. Dyer of Marlborough and Chas. G. Parker of Holden.

Secretary SESSIONS. The hour is nearing when we ought to adjourn. I want to recognize the assistance rendered by those gentlemen from outside the State, and the bountiful results that have come from the lectures and discussions during these meetings. The men who have so kindly come here at my request have exceeded my expectations, and my hearty thanks are due to them and due also to the members of the Board who have attended the meetings so closely and have stayed through the last afternoon session.

At my request, several questions have been placed in the question-box, with the understanding that they were to be answered if there was a lull in the discussion. None of you, I think, have seen a lull.

Mr. WOOD of Newton. As the discussion has continued beyond the usual time on the last afternoon, and seems to have arrived at a point where a definite statement of the views of the meeting can be formulated by the committee appointed by the chairman, I move that we now adjourn.

This motion was carried, and the meeting adjourned *sine die.*

## ANNUAL MEETING.

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The Board met at the office of the secretary, in Boston, on Tuesday, Feb. 3, 1891, at 12 o'clock, it being the Tuesday preceding the first Wednesday in February. In absence of the Governor, Hon. J. S. GRINNELL was elected president *pro tem.*

Present: Messrs. Appleton, J. D. Avery, J. G. Avery, Bancroft, Bird, Bowker, Bradley, Clemènce, Cruickshanks, Currier, Edson, Grinnell, Hartshorn, Harwood, Hayden, Hersey, Hickox, Holbrook, Horton, Howe, Loring, Newhall, Peterson, Pratt, Rawson, Rowley, Shaler, Shaw, Sheldon, Stockwell, Geo. S. Taylor, Hiram Taylor, Varnum, Ware and Wood.

A committee of three, to examine and report upon the credentials of newly elected members, was appointed by the Chair: Messrs. Bird, J. G. Avery and Bancroft.

On motion, a committee of three was appointed, to prepare resolutions on the death of Hon. Velorous Taft of West Upton: Messrs. Hartshorn, Hersey and Holbrook.

*Voted*, That a committee on legislation be appointed, whose duty shall be to recommend to the Board what legislation shall be asked of the Legislature, and to act for the Board in securing such legislation: Messrs. Wood, Hartshorn, Appleton and the secretary.

The committee on credentials of newly elected members reported the following: —

Amesbury and Salisbury Society, F. W. Sargent of Amesbury.
Attleborough, Isaac Alger of Attleborough.
Berkshire, Chas. A. Mills of South Williamstown.
Blackstone Valley, Henry A. Cook of Whitinsville.
Eastern Hampden, Dr. Wm. Holbrook of Palmer.
Hampden, C. F. Fowler of Westfield.
Hampshire, Franklin & Hampden, E. C. Clapp of Northampton.
Hingham, Edmund Hersey of Hingham.
Hoosac Valley, A. J. Bucklin of Adams.
Housatonic, J. H. Rowley of Egremont Plain.
Marshfield, L. S. Richards of Marshfield Hills.
Massachusetts, E. F. Bowditch of Framingham.
Massachusetts Horticultural, E. W. Wood of West Newton.
Middlesex, W. W. Rawson of Arlington.
Nantucket, Geo. H. Gardner of Nantucket.
Weymouth, Q. L. Reed of South Weymouth.
Worcester East, W. A. Kilbourn of South Lancaster.

The report of the committee on credentials was accepted.

Adjourned to 2 P.M.

Board called to order by Mr. Grinnell, at 2 P.M.

Reports of delegates being in order, the members made report of the societies to which they were assigned, which reports, thirty-five in number, were discussed and laid on the table.

At 4.30 o'clock the Board adjourned to 9.30 o'clock Wednesday.

## SECOND DAY.

The Board met at 9.30 A.M., Mr. Grinnell in the chair.

Present: His Excellency Governor Russell, Messrs. Alger, Appleton, J. D. Avery, J. G. Avery, Bancroft, Bird, Bowditch, Boykker, Bradley, Bucklin, Clapp, Clemence, Cook, Cruickshanks, Edson, Fowler, Gardner, Goodell, Grinnell, Hartshorn, Harwood, Hayden, Hersey, Hickox, Holbrook, Horton, Howe, Kilbourn, Mills, Newhall, Peter-

son, Pratt, Rawson, Reed, Rowley, Sargent, Shaler, Shaw, Sheldon, G. S. Taylor, H. Taylor, Varnum, Ware and Wood.

A committee of three, on assignment of delegates, was appointed: Messrs. Ware, Wood and Mills.

A committee of three, on place for holding the public winter meeting, was appointed: Messrs. Cruickshanks, Newhall and Hersey.

A committee of three, on changes of time for holding fairs, was appointed: Messrs. Bowditch, J. G. Avery and Holbrook.

A committee of three, to nominate members of the executive committee, was appointed: Messrs. Bird, Pratt and Clapp.

A committee of three, to nominate members of examining committee of the Agricultural College, was appointed: Messrs. Horton, H. Taylor and Hayden.

A committee of three, on essays for the next annual meeting, was appointed: Messrs. Bowker, Shaw and Clemence.

*Voted*, That the committee on legislation consider the propriety of asking the Legislature to amend section 2 of chapter 114 of the Public Statutes so as to change the time for filing the annual reports of the president and treasurer of the several societies as to the financial condition of the societies, from December 10 to January 10; and so as to require societies to make such financial returns as the Board may require, and if they shall think such amendment advisable, to have the necessary order introduced into the Legislature before the expiration of the time for introduction of new business.

The report of the examining committee of the Agricultural College was read by the chairman, Geo. S. Taylor, and was by vote of the Board accepted and adopted as the report of the Board of Agriculture to the Legislature.

The reports of the delegates to the several societies were read a second time by their titles, and accepted, and the

secretary was directed to edit and transmit the several reports to the societies, with instructions to print the same in their local papers or in their next annual transactions.

The Governor of the Commonwealth, who is a member of the Board, came in at 12.30 o'clock, but declined to take the chair as president of the Board, preferring to sit with the Board as a member thereof.

Geo. L. Clemence read an essay on "Care and Management of Milch Cows," which was accepted, and will be found printed in this volume.

At 12.30 the meeting adjourned to 2 P.M.

The Board was called to order at 2 P.M., Mr. GRINNELL in the chair.

The committee on place for holding the public winter meeting reported, by their chairman, that the meeting should be held at Horticultural Hall, Boston.

The report was accepted, and the Board voted to hold the next public winter meeting in Boston.

A committee of arrangements for the public winter meeting, to act with the secretary, was appointed: Messrs. Wood, Bowditch, Ware, Rawson, Appleton and Bowker.

Wm. H. Bowker read an essay on "The Massachusetts Board of Agriculture and the Agricultural Societies: can they broaden and improve their Work?" which was accepted, and will be found printed in this volume.

On motion of Mr. Appleton, *Voted*, That a special committee of five be appointed by the Chair, to whom shall be referred all essays read at this annual meeting and printed in the annual report, and who shall report at the next annual meeting any portion of these essays that the said committee deem advisable for this Board to take special action upon: Messrs. Appleton, Wood, Hersey, Shaler and Bowker.

On motion of Mr. Shaler, *Voted*, That a committee of three be appointed by the Chair to represent the Board in matters of legislation and agitation concerning the destruction of the gypsy moth: Messrs. Shaler, Appleton and Bird.

J. G. Avery read an essay on "The Farmer, his Relations to the Manufacturer and Mechanic," which was accepted, and will be found printed in this volume.

F. H. Appleton read an essay on "The Promotion of Agriculture," which was accepted, and will be found printed in this volume.

At 5.30 the Board adjourned to 9.30 o'clock, Thursday.

## THIRD DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: Messrs. Alger, Appleton, J. D. Avery, J. G. Avery, Bancroft, Bird, Bowditch, Bowker, Bucklin, Clapp, Clemence, Cook, Cruickshanks, Edson, Fowler, Gardner, Goodell, Grinnell, Hartshorn, Harwood, Hayden, Hersey, Holbrook, Horton, Howe, Kilbourn, Mills, Newhall, Pratt, Rawson, Rowley, Sargent, Shaler, Shaw, Taylor, Varnum, Ware and Wood.

Minutes of the two preceding days read and approved.

The committee to report names for executive committee reported as follows: Messrs. Bowditch, Hersey, Hartshorn, Rawson and Varnum, who were elected.

*Voted*, That the election of secretary and any other officers to be elected be assigned for 11 o'clock.

Mr. J. G. Avery, for the committee on change of time for holding fairs, reported that the time for holding the Amesbury and Salisbury be changed to the fourth Tuesday after the first Monday in September; the Bristol County, to the fifth Wednesday after the first Monday in September; the

Essex, to the third Tuesday after the first Monday in September; the Hampden, to the third Thursday after the first Monday in September; the Hampshire, to the fourth Tuesday after the first Monday in September; the Martha's Vineyard, to the fifth Tuesday after the first Monday in September; the Middlesex, to the third Tuesday after the first Monday in September; the Spencer, to the fourth Thursday after the first Monday in September; and that the time of the Worcester East be fixed at the second Thursday after the first Monday in September; the Attleborough, the fourth Tuesday after the first Monday in September; and the Weymouth, the fifth Wednesday after the first Monday in September. Report accepted and adopted, subject to the revision of the executive committee, as circumstances may seem in their judgment to warrant.

On motion of Mr. Appleton, *Voted*, That the committee on legislation be authorized to appear before the committee on federal relations, to whom was referred the Governor's message relating to the representation of this State at the World's Columbian Exposition at Chicago, and ask that the interests of agriculture be duly considered in any appropriation that may be made, and that the Agricultural College and the Experiment Station be included in their requests.

On motion of Mr. Appleton, *Voted*, That the following be referred to the special committee to whom was referred the essays, with instructions to report thereon at the next public winter meeting: —

The State Board of Agriculture, assembled at its annual meeting, recognizing the serious injuries to human health, which may and do too often result from the use of textile goods, whose attractive colors are sometimes produced by the use of arsenic, which is a poison, recommend that, when colored textile goods are bought for household comfort or wearing apparel, the seller shall, when required by the buyer, furnish a bill that shall state clearly that the goods sold are "free from arsenic," and that a fair sample of the goods (containing its several colors) shall then be

attached to the bill, and a second similar sample be preserved by the seller; and also recommend that a fixed price be established, at which competent chemists designated by the State Board of Agriculture shall make single analyses for arsenic in textile goods.

On motion of Mr. J. G. Avery, *Voted*, That the State Board of Agriculture, now in session, petition the Legislature for such legislation as will provide for ascertaining the number, location, value and other facts pertaining to the abandoned farms and farm lands in the State; also the most effective method of securing their reoccupancy.

Remarks were made by President Goodell of the Agricultural College, on the advisability of preparing a list of agricultural works as a nucleus of an agricultural library for town libraries or agricultural societies, stating that he received many applications for such a list, not only from different parts of the State but also from the State librarian, in the carrying out of the act "to promote the establishment and efficiency of free public libraries." On motion of Mr. Stockwell, Mr. Goodell was appointed a committee to prepare such list Mr. Goodell submitted the following, which was accepted and adopted, and ordered to be printed in the transactions of the Board.

Scott, Lawes, Morton and others, — "Soil of the Farm."
Stockbridge, — "Rocks and Soils: their origin, composition and characteristics."
Warrington, — "Chemistry of the Farm."
Storer, — "Agriculture in some of its Relations with Chemistry." (Two volumes.)
Frankland, — "Agricultural Chemistry."
Lloyd, — "Science of Agriculture."
Harris, — "Talks about Manures."
Gregory, — "Fertilizers."
French, — "Farm Drainage."
Johnson, — "How Crops Feed."
Johnson, — "How Crops Grow."
Masters, — "Plant Life on the Farm."
Beal, — "Grasses of North America."

Armsby, — "Manual of Cattle Feeding."
Stewart, — "Feeding Animals."
Arnold, — "American Dairying."
Sanders, — "Breeds of Live Stock."
Sanders, — "Horse Breeding."
Warfield, — "Cattle Breeding."
Randall, — "Practical Shepherd."
Shepard, — "The Hog in America."
Coburn, — "Swine Husbandry."
Harris, — "On the Pig."
Law, — "Veterinary Adviser."
Smith, — "A Manual of Veterinary Hygiene."
Billings, — "Animal Disease in its Relation to Public Health."
Murray, — "Cattle and their Diseases."
Steele, — "Diseases of Sheep, Ovine Pathology."
Harris, — "Insects injurious to Vegetation."
Saunders, — "Insects injurious to Fruits."
Barry, — "Fruit Growing."
Henderson, — "Gardening for Profit."
Cook, — "Manual of the Apiary."

Mr. Hartshorn, for the committee to prepare resolutions on the death of Hon. Velorous Taft of West Upton, reported the following: —

*Resolved*, That the State Board of Agriculture has lost by death several of its most influential members within the last few years. We remember with sadness the death of Wilder, Nichols, Moore, Lynde and Slade. It is with sorrow that we are again called to notice the death of one of our members. The Hon. Velorous Taft of West Upton died June 23, 1890. He had been an active member of this Board for many years. He was a man who not only had the interest of this Board at heart, but was foremost in advocating all progressive measures, whether relating to agriculture or to state or national affairs. His work was a life work; he did not relinquish it until called to higher fields by the great Master of the universe. We shall no longer hear his genial voice, or feel the hearty grasp of his hand that was prompted by a warm heart, or see his portly form again in our midst. But the good works of an honest

Christian man, and an earnest advocate of all moral and temperance principles, will live after him.

After appropriate remarks by Messrs. Peterson, Hersey, Rowley, Grinnell and the secretary, the resolve was accepted, and it was voted that it be spread upon the records, and a copy sent to the family of the deceased.

The committee on essays for the next annual meeting reported as follows: —

Essays.

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| The Reclamation of Marshes, . . . | N. S. Shaler. |
| Competition of the New England Farmer, | Chas. A. Mills. |
| The Employment of Farm Labor, . . | W. A. Kilbourn. |
| The Past and Future of the Board of Agriculture, . . . . . . | J. W. Stockwell. |

It being 11 o'clock, the special assignments were called up, and Wm. R. Sessions was re-elected secretary. C. L. Hartshorn was elected member of the Board of Control of the State Experiment Station for three years, in place of W. W. Rawson, whose term had expired. P. M. Harwood resigned from the Board of Control, and D. A. Horton was elected by ballot to fill out the unexpired term of Mr. Harwood.

D. A. Horton, for the committee to report names for the examining committee of the Agricultural College, reported the nomination of Dr. Wm. Holbrook and Chas. A. Mills, who were elected.

Mr. Appleton reported for the committee on forestry, which had been appointed by the executive committee to prepare a report to the Legislature, under an order of the House of Representatives of 1890.

*Voted*, That the report be accepted and adopted as the report of the Board to the House of Representatives, and that the secretary be instructed to transmit it to the House of Representatives.

The report will be found printed in this volume.

Mr. Ware, for the committee on assignment of delegates, reported the following: —

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| Amesbury and Salisbury, | H. Taylor. |
| Attleborough, | W. A. Kilbourn. |
| Barnstable County, | Q. L. Reed. |
| Berkshire, | Isaac Alger. |
| Blackstone Valley, | Nathan Edson. |
| Bristol County, | A. J. Bucklin. |
| Deerfield Valley, | F. W. Sargent. |
| Eastern Hampden, | N. W. Shaw. |
| Essex, | J. S. Grinnell. |
| Franklin County, | C. B. Hayden. |
| Hampden, | S. B. Bird. |
| Hampshire, | A. Pratt. |
| Hampshire, Franklin and Hampden, | G. L. Clemence. |
| Highland, | J. G. Avery. |
| Hillside, | E. C. Clapp. |
| Hingham, | B. P. Ware. |
| Hoosac Valley, | J. D. Avery. |
| Housatonic, | W. H. Bowker. |
| Massachusetts Horticultural, | G. Cruickshanks. |
| Marshfield, | D. M. Howe. |
| Martha's Vineyard, | E. Hersey. |
| Middlesex, | J. H. Rowley. |
| Middlesex North, | Wm. Holbrook. |
| Middlesex South, | A. C. Varnum. |
| Nantucket, | Chas. A. Mills. |
| Oxford, | C. F. Fowler. |
| Plymouth County, | C. L. Hartshorn. |
| Spencer, | D. A. Horton. |
| Union, | J. C. Newhall. |
| Weymouth, | G. H. Gardner. |
| Worcester, | E. W. Wood. |
| Worcester East, | N. S. Shaler. |
| Worcester North, | L. S. Richards. |
| Worcester North-west, | J. W. Stockwell. |
| Worcester South, | W. Bancroft. |
| Worcester County West, | H. A. Cook. |

Report accepted and adopted.

P. M. Harwood read an essay on "Essentials to Success in Farming," which was accepted, and will be found printed in this volume.

At 12.30 o'clock the Board adjourned to 2 P.M.

The Board was called to order at 2 P.M., Mr. GRINNELL in the chair.

The secretary presented a report upon the injurious and beneficial birds of Massachusetts, under a resolution of the House of Representatives of 1890. After slight amendment the report was accepted, and adopted as the report of the Board of Agriculture to the House of Representatives. The report will be found printed in this volume.

*Voted*, That the agricultural societies be required to print a revised list of their members in their transactions for 1891, unless such list has been printed in their transactions within three years.

*Voted*, That the societies be required to print in their transactions the names of the officers for each year ensuing their election.

*Voted*, That amounts paid in premiums to parties not residents of this State shall not be considered in predicating the amount of State bounty the societies shall receive.

*Voted*, That the secretary be instructed to notify the societies that they will be required to make their returns in strict compliance with the provisions of law and the regulations of the Board.

*Voted*, That any unfinished business or any new business that may arise before the next annual meeting be left in the hands of the executive committee, with power to act for the Board, and that they be a committee on printing.

A vote of thanks was unanimously tendered the chairman, Mr. GRINNELL, for the happy manner in which he had discharged his duty as presiding officer.

The minutes of the last day were then read and approved.

Adjourned.

WILLIAM R. SESSIONS,

*Secretary.*

## REPORT TO THE LEGISLATURE OF THE STATE BOARD OF AGRICULTURE ACTING AS OVERSEERS OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

[P. S., chap. 20, sect. 5, adopted by the Board Feb. 4, 1891.]

The committee appointed by this Board to examine the Agricultural College have the honor to submit their report as follows.

The Massachusetts Agricultural College, which has held an honorable position among the institutions of learning for more than twenty years, is still doing successful work, increasing in strength and efficiency, and taking rank among the first of its kind in this country.

Acting in behalf of this Board (which is by law a Board of Overseers of the college), your committee beg leave to mention some facts which perhaps may be familiar to some of our associates as they have had opportunities to gain the desired information; but to those who have not made the subject a study, a few words in regard to the purposes of the college, and the manner in which it was brought into existence, may be acceptable, although such facts have been frequently mentioned before in our reports.

In 1862 an act of Congress was passed, under the lead of Hon. Justin S. Morrill, United States Senator from Vermont, called the land grant act, donating public lands to such of the States and Territories as should provide colleges for the benefit of agriculture and the mechanic arts, the grant to be divided among the respective States and Territories, according to the number of inhabitants. It was thought by leading men in Congress and others interested in education upon a broad basis, at the time this act was passed, that these colleges would furnish a means of educating the industrial

classes, many of which otherwise could not afford a liberal education; our other colleges being more upon the English plan of providing an education suitable for young men anticipating entering upon professional life. One of the provisions of this act of Congress was, that it must be accepted by the various States, and the Legislature of Massachusetts passed an act in conformity therewith April 18, 1863. The act of incorporation was approved April 29, 1863; which provided for a Board of Trustees. A subsequent act made the Board of Agriculture a Board of Overseers, whose duties were to be defined by the Governor.

### The College Located.

After all other necessary preliminaries had been disposed of, the question as to where the college should be located became somewhat interesting. Applications were made by various towns, but Amherst came down with a $75,000 argument, and took the prize. This money was to be used towards the erection of buildings and other expenses in aid of the enterprise.

### Farm Purchased and Buildings Erected.

After it was voted to locate the college at Amherst, a farm was purchased containing nearly four hundred acres, from several separate and distinct estates; and buildings were erected, such as were suitable for a beginning, and the college opened for practical work Oct. 2, 1867, with a class of forty-six students; and the students, for several years in the early history of the college, were trained in practical as well as theoretical agriculture.

The college farm is situated about a mile north of the central village, and is well adapted to purposes for which it is used. The work of improvement has been constantly going on, such as underdraining, cleaning and improving unsightly and waste portions, removing old walls and fences, and placing long-neglected pastures under cultivation; until at the present time we have an estate worthy of being called the State agricultural farm, though there are still many improvements that might be made, and doubtless will be in time.

## Present Farm Management.

The farm is under the general management of Prof. Wm. P. Brooks (the professor of agriculture), with Mr. F. S. Cooley superintendent. Mr. Cooley is a native of Sunderland and a graduate of the college in the class of 1888, and began his duties in the capacity of superintendent last April. Your committee wish to acknowledge his attentions in conducting them over the large tract of territory embraced in the farm, during their inspection of the crops and stock. On our visit to the college in June your committee found under cultivation about twenty acres of corn (fourteen acres of field corn and six ensilage), six acres of oats, six acres of rye, two acres of beets, with such other vegetable crops as are necessary or profitable, all in good condition. Sixteen acres of pasture land were broken up last year. Ten of it are now devoted to corn, and six to oats; about one hundred acres in grass were looking well. The hay crop, it was estimated, would reach nearly two hundred tons, and there was a fair prospect of from seventy-five to one hundred tons of ensilage. In August, 1889, a system of drainage was begun to improve a tract of land of about thirty acres, and about five and a half miles are already laid. On this important and improved method of farm work the students have the benefit of both theory and practice. We found at this visit in June six students employed on the farm proper, and some eight or ten at the plant house. In speaking of the great task of underdraining this thirty-acre lot, Professor Brooks says, "Very much of the ditching for this work has been done by the students working under the provision of the labor fund, but for which our operations must have been far less extensive."

## Buildings.

Most of the college buildings originally erected, having had their day of usefulness, have given place to new and more commodious structures, which are finely situated, occupying a commanding site, from which point the scenic aspect of the town and its surroundings is very beautiful, being diversified by valleys, plains and swelling eminences.

## Annual Examination.

Your committee found the examination of the graduating class of '90 for the Grinnell prizes in agriculture a pleasant yet perplexing task: pleasant, because of the degree of promptness and correctness of answers; yet perplexing, because there was a considerable portion of the class deserving of prizes, and there were only two prizes to be awarded, and it was only after the most careful consideration that it was found that the first prize belonged to George Bradley Simonds of Ashby, and the second prize to John Samuel Loring of Shrewsbury. In accordance with this judgment the awards were made. The usual method of conducting these examinations is as follows: —

1. A topic is given to the class by the professor of agriculture, and each member is required to write out what he knows upon that subject. These papers or essays are handed to the committee for examination. This shows off the scholar of the class to the best advantage, but does not necessarily indicate the one best versed in the general subject of agriculture.

2. The class is called together before the committee for an oral examination, and here each member has a different subject, drawn by lot, assigned to him. This perhaps may be said to be as fair for one as for another; yet there is always a chance for a person to draw a topic with which he is especially familiar, and also for another to draw one about which he knows the least.

Had the prizes been awarded according to the impressions made upon the first examination of the papers, the results would have been different. So also if the oral examination alone had been considered. It is the average of these two (written and oral) examinations which counts. Your committee were especially pleased that their final decision, reached after so much consideration, was most heartily indorsed by the young men themselves.

Your committee looked over the farm as well as they could at the time of the annual commencement, but found this by no means sufficient for their purpose. Therefore in September we made another trip to Amherst, and devoted a

day to inspecting the farm, etc. Individual members of the committee have made special visits also during the year. To those of us who have been familiar with this farm from the beginning, the many improvements which have been made, especially during recent years, are most gratifying. That portion of the farm lying west of the college buildings, a large portion of which was once a swampy waste, is fast being made to bud and blossom like the rose. Here truly the Agricultural College comes under Dean Swift's definition of a public benefactor: "He who maketh two blades of grass to grow where but one grew before, is himself a public benefactor."

As we walked over this portion of the farm, and noted the system of underdraining there adopted by Professor Brooks, we appreciated the fact that here was an object lesson for the college students, where a practical illustration of the subject of underdraining could be seen, and thus impressed upon the mind more emphatically than any amount of mere word instruction could possibly do; an object lesson, not for these only, but also for every visiting farmer who avails himself of the opportunity. The same may be said of the model portable fence which we found there; of the different crops which we saw growing upon the farm; of the experiments being made to show the relative value of potash, phosphoric acid and nitrogen for crops upon the soil of the college farm; of the experiments being made with buckwheat, mustard, etc., as late-grown crops for ploughing under; and of many other ways which we observed, but will not take space to enumerate. We could but notice the splendid crops of corn nearly ready for the silo, also the crops of potatoes, beets, squashes, etc., all of which showed that intelligent care and cultivation becoming the circumstances. On going to the barn, we took special notice of the silo; as a matter of practical use, it seems to us that this silo is a model for the New England farmer. It is hardly within the province of this report to give a detailed description of it, other than to say that it is of wood structure after the most approved pattern, and is lined with a coating of coal tar, from which the volatile oils have been burned. This forms a hard, glossy, cheap and seemingly indestructible

lining. The ensilage in this silo keeps most admirably, and is a source of pardonable pride to Professor Brooks, under whose superintendence the silo was built. We found the barn and accompanying buildings not only improved but well kept, and the neat stock, horses, sheep, swine, etc., in fine condition. Professor Brooks is now experimenting with milk, testing its quality, etc., in different breeds of cattle. We are especially pleased to note the financial success thus far of his attempts at dairying with a new lot of cows bought during the last part of the year. But, as the professor will make an annual report, these and many other details will therein appear, and the bulletins of the Hatch Experiment Station will contain all that is being done under that management. We can only say that we wish that every farmer in the State would at some time or other visit the college, and the experiment stations there located.

These institutions are a God-send to the farmers, and may be said to be already indispensable to their welfare. At all events, the farmers who take advantage of their teachings have a long leverage over those who do not. The college has thus far received a liberal support from the Legislature of our State. It is a State institution. From the very nature of the case, annual wants will occur, and appropriations of money yearly become necessary. This year a barn is needed west of the Hatch experiment barn, for the economical storing of food and soiling of cows in summer, thus affording convenient means of increasing the fertility of that portion of the farm. The system of underdrainage is yet incomplete, and more tile is needed for the purpose. Additional farm implements are wanted for the more economical cultivating and harvesting of crops. A steam boiler is wanted to supply heat to the squash room, hospital stalls and piggery, which, as the professor says, are now as cold as Greenland's icy mountains; and he suggestively adds, "Here is a good chance to see which is cheapest in sustaining animal heat, — food or fuel."

### The Experiment Station.

The nearly fifty acres of land, under the eye of Dr. Goessmann, with the buildings specially arranged for the

experiments constantly being made there, should interest every farmer of our State. It would be of great advantage to any farmer to visit the station and follow the doctor around for one or more days, if he cannot spare as many weeks, and note the words of wisdom which fall from his lips. Go with him to the barns and pens, to the fields, and hear his lectures on the crops as he moves from plot to plot; go with him to his laboratory, let the farmer ask all the questions he pleases, and when the day is done he will find that the day has been well spent, with great profit to himself, and he will carry away much that will interest him in the days to come. The farmer should always take his pencil and memorandum book, and note down the many suggestions that he hears, and he will learn why the State and general government are willing to spend money at the Agricultural College, farm, and experiment station at Amherst. Your committee will again urge every farmer in the State to send his name to the station for its monthly bulletin, and carefully read the same. The committee always leave the doctor's presence wishing they had more time to spend with him.

### Botanic Department.

In performing our duties as examining committee of the Agricultural College, as prescribed by the Governor and Council, to inspect the property of the college, including the land and buildings, especially with reference to the adaptability and sufficiency thereof for accomplishing the object of the institution, we must say, after a careful study of the needs and advantages of the botanic department in numerous visits made in the past two years, we are led to make the following suggestions in relation to its improvement: —

It is believed by many friends of the college that the efforts now being made to make the department self-supporting should be given up, so that the whole energy of the professor of botany and horticulture and his assistants be given to making it more valuable to the students and the public in general. Its income from the sale of trees, plants, fruits and vegetables, has ranged from $2,000 to $7,500 per year, which has paid the running expenses, including fuel,

glass, paint, and much of the material and labor of ordinary repairs, with the exception of from $250 to $800 for its additional support. With this income has been grown annually more than 25,000 bedding and ornamental plants for the decoration of the grounds, and the care of the roads, walks, lawns and flower beds. The large, ornamental greenhouses now on the grounds must soon be extensively repaired or rebuilt. They have now been in use twenty-four years, and new houses more suitable for the required purpose and with all the modern improvements should replace them. The grounds of the botanical department, containing about one hundred acres, including the building site, forests, walks, lawns, etc., should be put in good condition by underdraining where necessary, and an abundance of manure for the most perfect growth of all ornamental trees, shrubs, fruits, vegetables and flowers. The department is well supplied with a large collection of ornamental trees and shrubs, both hardy and tender, under glass, most of which are labeled conspicuously, so that "he who runs may read." It has a large and complete collection of dried plants, including a valuable lot of parasitic fungi. Its laboratory is supplied with a large number of compound microscopes, with the necessary apparatus for the study of all kinds of plant tissues, including the rusts, smuts, blights, etc. It has complete spraying apparatus for the application of fungicides and insecticides, and tools for all horticultural work. While its equipment is large and well adapted to good work, the best results cannot be obtained while its efforts must be given to the production of an income wherewith to pay expenses. With the increase of funds now in the hands of the trustees, the botanic department should be supported in a way that its importance demands; for upon the knowledge of the structure and functions of the plant depends largely man's ability to produce the enormous quantity of food consumed by both man and beast.

### The Horticultural Department.

This department, in charge of Prof. S. T. Maynard, is in a prosperous condition. Experiments have been made with the Bordeaux mixture, to prevent mildew on the grape vines.

Vines so treated were free from mildew, both fruit and foliage. Those not treated with the mixture were so badly mildewed as to be worthless. Experiments are being made with strawberries, testing all worthy varieties, likewise blackberries and raspberries. Full reports may be found in the bulletins of the Hatch Experiment Station. The system of instruction has been the same as that followed during the preceding year; it seems well adapted to the needs of the students. For only one branch of the teaching — botany — does any immediate change seem desirable; on this subject it appears important to divide the work in such a manner that the students may learn more concerning the diseases of plants than they do at present. The modern science of vegetable pathology has in recent years made great advances, and it seems well worth while to train the young men in our agricultural college in such a way that they may be able to extend this learning, and apply the results in practice. The institution of an experiment station at the college appears to open a way to secure a very high grade of instruction in all that relates to the diseases of plants. Although this establishment is not a constituent part of the college, it may be possible to win from it material assistance in this most important branch of economic science, which will much increase the value of the teaching which our college offers to young men.

In conclusion, we commend the college to the farmers and citizens of the Commonwealth as an institution worthy of continued support.

Respectfully submitted,

GEO. S. TAYLOR.
GEORGE CRUICKSHANKS.
N. S. SHALER.
A. C. VARNUM.
P. M. HARWOOD.

## REPORT OF THE STATE BOARD OF AGRICULTURE TO THE HOUSE OF REPRESENTATIVES, UNDER THE ORDER OF FEB. 5, 1890.

On Feb. 5, 1890, the House of Representatives of our State passed the following: —

*Ordered*, that the State Board of Agriculture be instructed to inquire into the condition of the forests of the State, the need and method of their protection for sanitary and other reasons, and the encouragement of tree planting, and report thereon to the next General Court.

The matter was referred by the Executive Committee of the Board of Agriculture to a sub-committee, consisting of Messrs. Hersey, Sessions, and the writer. No appropriation having been made for carrying out the provisions of this order, which is only limited in its scope by the boundaries of the State, the committee were confined in their work to narrower limits, especially as the regular appropriations had been almost completely allotted for special work.

The last census return, of the amount of woodlands, told us that thirty-six per cent of the surface of the State was in such condition, and this served as a basis for such work as could be done Each member then began to secure information. All have traveled somewhat, and have sought information from other persons and sources.

Among methods employed, the writer prepared a list of questions, as to what courses it would be well to adopt, and submitted them to Prof. C. S. Sargent of the Arnold Arboretum, to which he kindly replied. A list of questions, suitable to be sent throughout the State, was suggested to the committee, but the way did not seem to be clear for sending them out, and that plan was abandoned.

As the American Forestry Association met in Quebec the past autumn, this fact suggested a possible means of obtaining light upon the subject; and the writer, a member of that association, with credentials as delegate from this State, submitted a communication of inquiry upon the subject of forestry, bearing on the order received from the Legislature, and it was referred to one of their members, Prof. B. E. Fernow, chief of the forestry division of the department of agriculture at Washington, whose letter in reply is submitted herewith.

UNITED STATES DEPARTMENT OF AGRICULTURE, FORESTRY DIVISION,
WASHINGTON, D. C., Sept. 23, 1890.

FRANCIS H. APPLETON, Esq., *Lynnfield, Mass.*

DEAR SIR: — Your paper, directed to Dr. Fisher, for the Quebec meeting, was referred to me for reply, since there was no opportunity to discuss it at the meeting.

I do not know that I can do much to aid you, except perhaps to throw out a few suggestions which occur to me as I read your letter. First, let us understand that the whole forestry movement is one that cannot be expected to come to an issue in a short time; it is as much a matter of economic development as of education.

As far as legislating can effect anything, I believe Massachusetts has done as well as any State in regard to her forestry interests. The effect of your act enabling towns to own communal forests, in creating the public forest at Lynn, shows that, where the citizens are really alive to the question, they will take advantage of the law. What is needed is, that citizens be made alive and aware of the advantages accruing from the application of the law, and they will apply it. This suggests an educational campaign on the part of the State Board of Agriculture, in which, at farmers' meetings, plain, practical talks, leaving out all theories of forest influences, timber famine, etc., show the advantages, direct and indirect, of caring for your forest property, by which care the distinction between forest and woodlands is established. If I were to define the word "forest," in contradistinction to woodland, I would say that the latter is the natural growth left to itself and without care, while a forest is an area of woodland, kept as such for the production of wood (timber or cord wood) under proper care and management. The *woodland becomes a forest when it is placed under management.*

The educational campaign, which you recognize as necessary, it seems to me should be conducted in all phases simultaneously, in the school as well as the convention, etc. Unfortunately, we are short of educators and educational means. There is no text-book fit to be introduced in the schools, there is no guide to be handed to the would-be forester; and here, too, we will have to be patient until these are provided, meanwhile doing the best we can for the time, to keep people on the lookout for scraps of knowledge we gather and disseminate.

As to the good effect of exemption from taxation, this is questionable; the tax amounts to but little; and, after all, it is not that we want to prevent the cutting, but only the wanton cutting without care for reproduction.

If you want any definite advance in the forestry interests of your State, place them in the hands of one man, whose sole duty is to look after them, and pay him for that. We are doing too much dilettante work in this and other lines, and in the multiplication of our duties we cannot do any one well.

Your paper I have returned to Dr. Fisher.

Hoping to have, at least in part, suitably replied to your communication,

I am yours very truly,

B. E. FERNOW,
*Chief of Forestry Division.*

It is thereby seen that Professor Fernow compliments the State on being in the advance as to laws, but can see room for still further advancement in woodland management.

We thereby see that we must wait patiently for proper text-books upon the subject, and then look for a greater popular desire or demand for knowledge to arise, which shall result in its being gratified; and a scientific treatment of our woods follow, that should give us real forests in accordance with Professor Fernow's definition of them. We know that older countries have found such treatment indispensable, and it can be only a matter of time before forestry management will be deemed necessary here. We must "be patient," meanwhile, doing the best we can to keep the subject before the people, in the hope that we shall be provided with suitable text-books for both school and forester when they are needed.

It might be helpful to print, in some collective form, our State laws relating to our woodlands, which encourage their increase and aid their protection, and perhaps to incorporate them in the next report of the Board.

It has been suggested that the State present seedling trees to the owners of poor, uncultivated land, for planting in circular groups where the land would be improved by being turned into woodland, provided the owners will agree to plant and care for them; the object being to experiment to a limited extent in attempting to secure a new growth of trees that would eventually seed the surrounding land. The question however, arises, whether the State would be authorized to so act, while, from a hygienic or sanitary point of view, no actual necessity for more woodland seems to exist. In this connection it may be recalled that the Massachusetts Society for Promoting Agriculture, with which two members of this Board are associated, has, within the past fifteen or twenty years, offered prizes ranging from \$1,000 to \$50, in the hope of encouraging tree planting on such land as has been referred to; but the extent to which they have succeeded in establishing new plantations has fallen short of what their very liberal and varied prizes might seem to have warranted.

But this experience is referred to in order that those who have been familiar with it, or now have their attention called to it for the first time, may not be misled thereby, as the results have been of much value in the various localities where plantations were entered for prizes. Indeed, the good results, especially in the cases where the prizes were awarded, together with similar results in previous well-known plantations of the Messrs. Fay at Wood's Holl and Lynn respectively, Mr. Kendrick, Mr. Pratt of Middleborough, plantations at Nantucket and Martha's Vineyard, Mrs. Phillips' success at North Beverly, Mr. French's at North Andover, with others, are proof of the success that can attend like plantings in parts of the State where this work is now unknown, and where, it is thought, instructive and experimental plantations could be established to the advantage of this Commonwealth.

These would also increase the desire for a better treat-

ment of our woodlands, and would tend to make "useful land" of that which is now unused, and would also tend, in course of time, to establish forestry, an occupation among us, which will, by and by, give employment of a kind that does not now exist. A well-planned system of subsidies by gift of seedling trees, or tree seeds, would be a good way to secure further valuable educational results.

Reckless methods of cutting have done much to lessen the value and retard the growth of woodlands. Selling wood on the stump, without proper restriction as to the way the land should be left, is also injurious. The complete cutting off of a wood lot greatly delays or prevents early reseeding, and the renewal of the growth of wood. The influence of this Board should be thrown to secure the leaving of seed-bearing and young trees scattered over the land in the interest of the owner and the State; which should be done most particularly in the case of evergreen trees, that demand this course, where the planting of seedlings does not follow the cutting down of the mature trees.

The method of raising trees from seed, now used and recommended by Mr. Jackson Dawson, of the Arnold Arboretum, which is practical and easy, and which was lately given in the transactions of the Massachusetts Horticultural Society, might also be reprinted in small pamphlet form for distribution; and farmers' clubs and similar organizations should be persuaded to put it into practical operation. Mr. Dawson has described his method as follows: —

To those who might wish to plant an acre or so every year, and want no failures, I would recommend another system, which requires less space and labor, though possibly more attention; but in the end any one could transplant the most difficult trees, such as oak, hickory or chestnut, with no loss. For want of a better name, I have called it the "box system." No doubt it has often been used, but I have not heard of any one using it largely except myself. By this method every root is preserved, and not even a fibre destroyed; there are few if any large tap roots to cut off, and, even if grown in the nursery afterwards, they lift with finer roots than the seedlings grown in the ordinary way; and, though they will not make so vigorous a growth the first year as they

would in the open seed bed, at the end of the second year after transplanting they are ahead of those of the same age grown in the ordinary way, and with no failures. Nine years ago we transplanted from the seed boxes to a hill-side, in sod ground with no preparation except to turn over the sod with a spade where each tree was to go, some hundreds of oaks one year old; and to-day they are fine young trees, from six to nine feet high, well formed, and much more vigorous than those grown in the nursery, which have had a great amount of care and labor bestowed upon them. I believe that, if many of our early planters had used this system in growing oaks, hickories and other hard-wood trees, they would not have had so many failures to complain of.

In the first place, procure a lot of common boxes, such as may be had at any grocery store; any kind of boxes will do, though a uniform size is best, as they occupy less space in a six-foot frame, when packed away, than boxes of various sizes would. I usually get those that have contained canned goods or soap, as they are nearly equal in size, and with two cuts of a splitting-saw you have from each box three flats, from three to four inches deep, which is a good depth for any ordinary seed. With a half-inch auger bore three or four holes in the bottom of each box, for drainage. This will be sufficient for large-rooted plants, while the finer seeds will require to be well drained with broken pots, coarse siftings of peat, or any coarse material that will allow the moisture to pass off readily. As soon as the seeds are ripe, in the fall, get together a good pile of compost, made as follows: two parts rotten sod, one part peat and one of sand, and, if the seeds to be sown are oak, hickory, beech, chestnut or walnut, add a portion of good rotten manure. For such seeds as I have mentioned, fill your boxes two-thirds full of the compost, and press down firmly with a board or the hand. Sow the seeds evenly, and press them down in the soil, covering them from half an inch to an inch in depth, according to their size. On one corner of each box smooth off a place with a plane or knife, rub over with white lead, and write the name of the seed and the date of sowing. This takes only a few minutes, and is of much value afterwards, especially where a great variety of seeds is sown. It is much better than labeling in the ordinary way, and there is no danger of the record being lost in moving the boxes from one position to the other. The finest seeds, such as maples, elms, birches, alders and others, should be covered, according to the size of the seeds, about their own diameter. After sowing, the seeds should have a good watering with a fine rose, to settle the soil. The boxes can then be piled four or five deep in a pit, the sashes placed in it, and at

the approach of cold weather they may be covered with meadow hay or leaves. This does not keep the boxes from freezing, but, when once frozen, it keeps them so until spring. If no pit is available, the boxes can be piled six or seven deep in a well-sheltered spot, covering the upper boxes with a few boards, the whole to be covered with leaves or other litter. In the case of all the seeds I have mentioned as taking one or more years to germinate, it is unnecessary to cover the boxes with litter; but it is well to cover with boards, so that mice or squirrels may not get at the seed; and in many cases seed that has been so frozen will often come up the first season, which otherwise would not have come until the second.

As soon as the weather is settled, which is usually about the middle of April, choose a well-sheltered spot, level, and handy to water. If the aspect can be an eastern or south-eastern one, I like it better, as they get the early morning sun, but not the scorching sun at noonday. Place all the boxes containing the nuts, acorns and other large seeds together, in beds of three boxes wide. This will make it very compact, and much easier to care for them than if the boxes containing seeds of the same class are scattered about. The only attention these will require is to keep them well watered and free from weeds; but for such seeds as maple, ash, elm and others of like nature, it would be well to cover the boxes with lath screens until they have made the second or third rough leaf, when they might be gradually hardened off, and finally exposed fully to air and light. If a few sashes could be spread to protect all delicate growing seeds, it would be of great advantage, and as soon as well up they could be treated the same as the others.

The use of lath screens on seed beds saves a great amount of labor in watering, and, if the plants are neglected for an hour or so, the results are not so disastrous as when the young seedlings are fully exposed to the sun. Any boxes of seeds that do not come up before the last of June will hardly appear that year, but will require to be kept moist, the same as the growing plants. I usually place all such boxes together in a shady spot, and cover them to the depth of an inch or more with sphagnum (a kind of moss), and, by giving them a good watering once or twice a week, they are carried safely through the summer. At the approach of cold weather they are gathered together, piled five or six deep, as before, and covered for the winter. When spring comes on they will need to be treated as seed that has just been sown. For the finer seeds, such as azalea, rhododendron, kalmia and others, a special treatment is required, which I will speak of later.

In the fall of the first year the boxes of young trees may be

gathered together and wintered in a deep pit or frame, and slightly covered with meadow hay. If no frame is available, three or four inches of pine needles or leaves may be placed over the boxes, and they may then be left until spring; but on no account should the boxes be left without any protection, as the young seedlings will then suffer very much in so little depth of soil.

All seedling trees can be transplanted when very young, as easily as cabbages or tomatoes, if taken as good care of, and many of them are benefited by the operation. We transplant thousands of them every year, with but little loss. The best time is when they are making their first or second rough leaf.

In the spring of the second year all the young seedlings should be transplanted from the seed boxes to the nursery beds, or the larger ones planted where they are to remain; and for chestnuts, hickories and oaks, I believe it is best to plant them from the seed box to the field where they are to remain. If planted in nursery beds or rows, the treatment will be the same as I have spoken of under the head of treatment in nurseries.

The boxes I have mentioned are usually from fourteen to sixteen inches square, and will hold from one hundred to one hundred and twenty-five oaks, hickories, chestnuts or beeches, one hundred and seventy-five to two hundred ashes or maples, two hundred and fifty birches or elms, and so on, according to the growth of the plants. Where a greenhouse can be used for this purpose, with frames to harden off the young seedlings, much better results can be obtained and many of the finer seeds can be grown, which it is next to impossible to grow in large quantities out of doors.

In conclusion, I would say that, while I have not mentioned every tree by itself, the general principles are the same for all; that, as a rule, the soil should be of the best description, and sheltered; that all seeds should be covered only a little, if any, deeper than the diameter of the seed; but they should be kept clean from weeds, the watering well looked to, and the shading, in the case of the finer seeds, be carefully attended to. They should be protected the first season, and in the end will well repay all the care and attention that have been bestowed upon them; and any one owning a few acres of land, who will plant a few boxes of chestnut, black-walnut, beech, oak, hickory, or other hard-wood trees, that are usually considered so difficult to transplant, after growing them one year in the boxes and transplanting the following spring where they are to remain, will be astonished to see how much land can be covered in a few years with healthy young growths of hard wood, with very little trouble or expense. In New England, as well as in other parts of our country, we have

too many acres lying idle, which it would be more profitable to plant with trees than anything else.

Mr. Dawson ends by commending the idea of clothing the unused and unwisely cultivated land with trees.

While in attendance upon the joint meeting of the American Economic and Forestry Associations at Washington, on December 30 last, I introduced the subject of the woodlands of this State; and the act of 1882 (chapter 255, Public Statutes, sections 1–5) was referred to, which gives this Board power to act as a board of forestry. The public reservation of forest land in the city of Lynn was referred to in words of high praise, and the question arose as to whether such reservation was taken under the act just referred to. Such is not the case, but the Lynn reservation is held by that city, and not held by her under that act.

It was then suggested that said act be so altered, or a new act passed, giving this Board the power to take stump land or waste land at a low valuation; the title to rest in the State; this Board to act as a board of forestry without pay, and to employ a trained forester to have full charge of the property when held in sufficient quantity.

In the older countries the government finds it not only necessary but profitable to own and manage forest land; and in Europe many nations have their system of forestry schools, and forest workmen who are organized very much like a military corps.

We have this precedent to follow, and it may be advisable to suggest that the Legislature consider this subject in its several phases. But the power to take the land, and raise the money to pay for it, would have to be given. After the land was secured, it should early yield enough to pay for its management, and later yield an income to the State, and form a sinking fund to eventually extinguish any bonds which might have been issued to raise money for payment As the land would probably be taken in the poorer part of the State, it would probably be advisable to give a bonus to the towns in which it was situated, or to continue an annual payment to the towns, equivalent to the amount of tax raised on said lands at the time of this taking. When build-

ings were to be included in the taking, their use could be continued until death or removal of the occupants. Otherwise, such taking would be burdensome to those towns at first; but, as the woodland became forest and the necessary roads for drawing out the wood or timber were built, the improvement might result in increasing the attractiveness of the townships, and a consequent increase in the valuation of surrounding property might result to the benefit of the towns where the forests were located.

While this represents a course that I believe the government must take in due course of time, providing individuals do not see profit in taking up the subject, the question arises whether it is yet time for the Legislature to seriously consider it. To reply to the legislative order, we might respectfully say that we find thirty-six per cent of our acreage in wood and sprout land, which is increasing in quantity, with but little forest land in it, and that lumber is cut only for local use, except perhaps in comparatively insignificant quantity; as to the need of protecting them, the laws seem good, but public opinion often has too little consideration for the value of woodland property, and too little of the danger to it from fire. Its injury or destruction often results from sources that cannot be proved.

In considering our woodlands from a sanitary or other stand-point, it may be said that the small proportion of old forest must lessen the value of our woods as a source of water supply in the State, because forest land is productive of springs; although springs are sometimes found in open hill-sides, as, for example, those supplying Cottage City and Vineyard Haven. The forests, when surrounding the reservoirs of water supplies, — as has been accomplished in the city of Lynn, — are a very important means of protecting the purity of the water, and consequently the health of our people, when such water is used for domestic purposes.

The large proportion that the woodland acreage bears to the total acreage of the State would seem to be sufficient for economic purposes, so far as acreage can affect it; but its quality and condition is open to much criticism and great improvement.

There is also much land that is now poor and uncultivated, which would be more useful if it could be covered with a judicious selection of evergreen or deciduous trees; but the present laws permit cities and towns to acquire such land for the purpose of cultivating trees, although these laws do not appear to be in a form acceptable to cities and towns; and such power has been exercised under special acts.

The power not having yet been exercised by cities or towns, to my knowledge, *under the present general act*, the question arises whether this power can at some time be wisely transferred to the State, with a certain limit as to price to be paid for the land. On general principles, and considering the State (or country) as one large whole, belonging to no one generation of men, but held in trust by its governing body, to be intelligently protected in the interest of present and all future generations alike, we see (especially after the experience of older countries, particularly France) that our hill lands should be retained in woods, as a protection against severe blasts and winds in general, and as guardians of the sources of moisture upon which the fertility of the valley land is dependent, and to prevent the washing into the valleys of the soil from the hills, which can only be replaced by great length of time and heavy expense.

In France, as the population increased, and as all available land was demanded for the uses of the country at a more recent period in her history, it became necessary to reclaim her mountain sides and tops, once wooded, from a barren waste to forests again; and, in consequence of the stripping off of rooted growth, the soil had been gradually washed from the mountain sides into the valleys, streams had made new courses and multiplied them, so that it became necessary for the government of France to be put to enormous expense for building dams, and otherwise, to enable them to again regain control of those streams and send them back to fixed channels, so that young trees could be planted over the hills again to gradually remake the soil, reform the springs, and preserve both for the good of France. A costly example was thus set to the world.

Where plantations are to be made, the greatest care

should be exercised as to choosing kinds of trees, and it has been found safest to use the kinds which are native to the locality of the plantation; but where there are, for good reasons, any doubts as to the best varieties, the opinion of the most competent authorities within reach should be obtained. It must be remembered, with our postal-card system, long distances are greatly shortened, and thereby advice can be secured from the best sources, independent of distance.

We have now in this country men who, having grown up and been educated here, have since been students in the forestry schools of countries where the enforcement of forestry laws has become a necessity, and who are capable of examining and giving us intelligent instruction and advice upon how Massachusetts, as a State, or by her people individually, can best care for her thirty-six per cent and more of woodland, and her unused open lands.

It is recommended that the Legislature appropriate a sum sufficient to have such an experienced man inspect our woodlands, and then report, as early as possible, directly to either the Legislature or to the Board of Agriculture, or to the people by lectures, at such times and places as may be decided; and also appropriate a sum sufficient to distribute a limited number of seedling trees or seeds in different parts of the State, as an experiment, under direction of the Board of Agriculture; but *only where a guarantee is given* that the work will be well done and the plantation receive due care. A report to be required of all cases at intervals.

If this Board deems the course which is suggested advisable, and are ready to give it their hearty support, should the Legislature think well enough of it to pass it, I, for one, hope the suggestions will be adopted, for I believe in them; but, without the ready co-operation of this Board so far as it might be asked, to help carry out the plan, it would fail largely of its purpose.

The following is presented, in conclusion: —

The State Board of Agriculture, in reply to the order received from the House of Representatives on Feb. 5, 1890, respectfully submit that part of an address which relates to the subject of woodlands, forestry, etc., and would suggest, —

First, that a sum of $1,000 be appropriated for the purchase and distribution of seedling trees, or tree seeds, to be given under their direction to owners of land, who will agree to plant or sow, and care for them under the direction of, and at all times hold them in readiness for inspection by, this Board.

Second, that the sum of $2,000 be appropriated to secure a general inspection of the character of the woodlands, and poor, unused lands of the State, by a competent person, who shall be thoroughly familiar with the best management of woodlands in the older countries of Europe, and report to this Board his opinion as to the best methods of caring for such woodlands and poor, unused lands, as early as possible.

FRANCIS H. APPLETON,

*For the Committee.*

## REPORT OF THE STATE BOARD OF AGRICULTURE TO THE HOUSE OF REPRESENTATIVES UNDER THE RESOLUTION OF MAY 28, 1890.

The Massachusetts House of Representatives adopted the following resolution May 28, 1890: —

*Resolved*, That the Board of Agriculture of Massachusetts be and they are hereby requested to make inquiry and investigation as to the birds that inhabit the State, and report thereon as to their character, habit and value as insect destroying and grain and fruit destroying birds, and advise on such legislation as may be necessary for the protection of private and public interests.

In accordance with this resolution, the Board of Agriculture employed Dr. B. H. Warren, State ornithologist of Pennsylvania, to prepare and deliver a lecture, on the birds of Massachusetts, at their public winter meeting in Worcester, December 3. This lecture and the lengthy discussion which followed will be found printed in the report of the Board of Agriculture of Massachusetts for 1890.

The Board, by its secretary, have made careful observations and inquiries of intelligent gentlemen in our own State, and have corresponded with ornithologists abroad, and beg to report that, as a whole, the native birds of Massachusetts are benefactors. The small losses occasioned by the raids of some species upon our fruit trees, gardens, grain fields and poultry yards are repaid manyfold by the benefits resulting from the destruction of injurious insects, field mice and other vermin that are a detriment to agriculture. It is, however, the opinion of ornithologists that crows cause a greater loss in the corn fields, and by destroying the eggs and young of useful birds, than they are capable of repaying by the exercise of their good qualities and habits.

Most of our birds of prey, as hawks and owls, do more or less damage in the poultry yard, and by destroying use-

ful birds; but their services in the destruction of field vermin more than makes good that damage in the aggregate.

The song birds are all useful to the agriculturist. We cannot say as much for the English sparrow. The best ornithological authorities in this country agree that the young birds while they remain in the nest are fed partly on insects and partly on grain, fruit, and flowers of fruit trees, but that the mature birds subsist entirely on a vegetable diet.

Dr. B. H. Warren, State ornithologist of Pennsylvania, says: —

Between thirty and forty species of the sparrow family (*Fringillidæ*) occur in Massachusetts, and about twenty are said to breed here. Of this large number the English sparrow is the only species regarded by naturalists as being detrimental to the interests of agriculture. The English or European house sparrow, an abundant resident about buildings, nests in bird boxes, holes in trees or branches of trees, in vines and in various places about houses and other buildings. The nest is composed of dried grasses, pieces of string, etc., lined with an abundance of feathers. The dull-whitish eggs, from four to seven in number, are thickly spotted and streaked with different shades of brown. In this locality at least two and probably more broods are reared in a season. The English sparrow, as this species is commonly known throughout the United States, is universally despised by farmers, fruit growers and naturalists, because of its pernicious habits. In the spring it feeds largely on the buds of fruit trees, bushes and vines, chief among which may be mentioned the pear, apple, peach, plum, cherry, currant and grape. Different garden products, such as lettuce, beans, peas, cabbage, berries, pears, apples and grapes, are greedily fed upon. The sparrow greatly damages the corn crop, tearing open the husks, devouring the tender part of the ear, and exposing the remainder to the ravages of the insects and the atmospheric changes. It alights on fields of wheat, oats and barley, consuming a large quantity, and, by swaying to and fro on the tender stalks and flapping its wings, showers the remainder on the ground. In addition to a much-varied vegetable diet, the sparrow has been known to kill and devour the young of other small birds. Our native song and insectivorous birds, viz., the robin, bluebird, wren, chippy, song sparrow, red-eyed vireo and some few others, which were formerly plentiful residents in

our lawns, parks and gardens, have rapidly and steadily diminished since the hosts of pugnacious sparrows have appeared. This species is more or less gregarious at all seasons of the year. When not engaged in rearing their young, they are always observed in flocks. In the late summer and autumn they assemble in flocks of hundreds, and daily repair to the wheat and corn fields in the vicinity of cities and towns, where they commit serious depredations that are only checked by harvesting the crops.

Professor Everhart and myself examined the stomach contents of one hundred and fourteen English sparrows captured in the borough of West Chester and vicinity during all the months of the year. Fourteen of those birds were young ones taken from the nest, the others were adult birds. Of this number, five had fed upon insects, the balance had subsisted on cereals and the buds and blossoms of fruit trees, and on numerous garden products. Now, there is one thing which you will often hear asserted by persons who attempt to defend the English sparrow. They say, "You naturalists will never investigate the food of young birds. Sparrows feed their young exclusively on insects, hence are highly beneficial." Now, I will state that the English sparrow, and in fact all birds, with a few exceptions (we have exceptions to nearly all rules), feed their young on an animal diet. The sparrow is not an exception to this rule. Young English sparrows are fed in part on different forms of insect life, but, as I have already told you, the adult birds not only feed their young, but themselves eat, a vast amount of vegetable matter, and the bird should be destroyed. One of the characteristic features of the sparrow, in fact, the chief characteristic, is his heavy, cone-shaped bill. When you see such a bill on any bird, it shows that he feeds on a grain or seed diet, because that bill is adapted especially to the breaking up of seeds. Now, take a bird that feeds on insects. Such, for instance, is the whippoorwill. This bird feeds exclusively on insects, such as beetles. It has a soft bill, and one which will readily bend. It is, strictly speaking, an insectivorous bird. Take our common barn-swallow. This bird has a bill adapted to feeding on insects. It has not a bill built for the purpose of crushing, as is the bill of the sparrow. Any bird that has a heavy bill is a grain-eating bird.

In 1889 the United States department of agriculture issued a bulletin on the English sparrow in North America. This pamphlet consists of about four hundred pages, and is an exhaustive consideration of the subject, in all its bearings. It shows that the English sparrow is increasing with wonder-

ful rapidity, and is spreading over the whole country, having, in fact, already occupied almost all the thickly settled portions. Returns were secured from all parts of the country, from friends of the sparrow as well as from its enemies. It seems well substantiated that where they have become numerous they attack apples, pears, grapes and all kinds of small fruits, eating and destroying both flowers and fruit in their season. Garden vegetables suffer from their ravages, particularly peas, tomatoes and lettuce. Garden seeds are also largely preyed upon. All kinds of grain are their natural food, and their ravages on fields just sown and on the ripened grain are in proportion to the number of the birds in the vicinity.

The English sparrow is an enemy to our native birds. No less than seventy species are reported to suffer from their attacks, and many of them have been driven from their native homes by these emigrants.

Post-mortem examinations made by Prof. C. V. Riley and Dr. B. H. Warren for the United States department of agriculture show that the amount of insect food which the English sparrow consumes is very small compared with the amount of vegetable food; and the conclusion of the department and of the American Ornithologists' Union, whose members made many observations for the department, was that the English sparrow (*Passer domesticus*) was not only of no benefit to the country, but was a positive injury, and Dr. C. Hart Merriam, ornithologist to the United States department of agriculture, officially recommended the repeal of all laws protecting English sparrows.

Thinking that information direct from the native home of the English sparrow would be interesting, the secretary of this Board in July last wrote the secretary of the Royal Agricultural Society of England, stating the action of our last Legislature, and asking what English authorities say upon the habits of this bird. His reply was as follows: —

Royal Agricultural Society of England,
12 Hanover Square, London, W., July 23, 1890.

Dear Sir: — On receipt of your letter of the 3d instant, I thought it best to call for a memorandum on the subject from the society's consulting entomologist, and a copy of this memorandum

I enclose herewith. I have sent you by book post a copy of the work on the house sparrow, to which Miss Ormerod refers.

If there is any further information which the society can afford the Massachusetts Board of Agriculture on this or any other question, I trust that you will not hesitate to apply to me.

Believe me, yours faithfully,

ERNEST CLARKE,
*Secretary.*

*The Secretary Massachusetts Board of Agriculture,*
*Commonwealth Building, Boston.*

The memorandum of the consulting entomologist of the society, Miss Eleanor A. Ormerod, referred to in his reply, is as follows: —

### MEMORANDUM BY CONSULTING ENTOMOLOGIST.

We have no published reports here on the subject of the house sparrow (the corn sparrow, to give it one of its German names; *Passer domesticus*, scientifically) equalling in authority or scope of observation the "American Ornithologists' Union," of which the verdict was given, on careful consideration of evidence, at a meeting held in Washington on April 21, 1885, and was strongly condemnatory of favoring the sparrows.

Nor have we such well worked out notes of observation as those of Dr. C. Hart Merriam, ornithologist to the United States Department of Agriculture, and printed in the annual report of the department of agriculture for 1886, in which he officially recommends, from evidence given, the repeal of all laws protecting the "English" sparrow. And, again, a valuable paper was submitted by Prof. C. V. Riley, entomologist of the United States department of agriculture, to the Biological Society of Washington (this at a date previous to April 26, 1888), in which he also proved the "worthlessness of the sparrow as an insect killer."

We have no papers of this authority here, but there is good and perfectly reliable information given on the subject in papers by J. H. Gurney of Keswick Hall, Norwich, and by the late Colonel Russell of Stubbers, Romford, Essex, in a small book entitled "The House Sparrow," published in 1885 by Wesley & Son, of Essex Street, Strand, London. Colonel Russell's observations were valuable and reliable. He carried them on for upwards of fifteen or twenty years, and gave evidence on the subject before a committee of our House of Commons.

I have now in my possession a series of bottles containing the contents of sparrows killed by Colonel Russell during many years,

and preserved by him as evidence of the great proportion of corn in their food. These bottles have in some cases slips affixed with year, month and day, and number and age of sparrows of which the contents are preserved.

There is an enormous amount of matter printed on the subject, but a great part is complaints of fields and gardens devastated by flocks of sparrows; and on the other side much unscientific writing on the subject of cruelty, etc.

I have *personal* knowledge of the great mischief these birds are causing here, up even to having seen a whole field so ravaged by them that the sickle is not put in. I know them, both by my own observation and reports of reliable contributors, to be lessening the number of martins and swallows (truly insectivorous birds); and, from reports from known entomological or ornithological or agricultural or horticultural contributors, continued year by year, I have no doubt (that is to say, there is plain evidence given) that this one species of bird — the *Passer domesticus* — is a cause of very severe loss in this country.

ELEANOR A. ORMEROD,
*Consulting Entomologist of the Royal Agricultural Society of England.*

JULY 15, 1890.

The book referred to in the letter of the secretary of the Royal Agricultural Society is an arraignment of the sparrow and his conviction as an enemy to the agriculture of England; not only for the immense amount of direct damage he inflicts upon the agricultural products of the country, but for driving away the more useful insectivorous birds. It will be observed that the entomologist of the Royal Agricultural Society considers the investigations of the American Ornithologists' Union and the agents of the United States department of agriculture as most thorough, and their conclusions against the sparrow as entirely reliable.

The Massachusetts State Board of Agriculture, from their own observations and from the opinions of ornithologists, conclude that the laws of Massachusetts in regard to the birds of Massachusetts are very nearly what they should be, and would recommend no legislation except in regard to the English sparrow. The Board believes that the law of 1890, chapter 443 of that year, has not been enforced, and would suggest that it might be amended so as to allow the use of

poison during the winter months, when none of our insectivorous birds would be in danger of being destroyed by it. It is feasible to expose poison for sparrows in winter time in such ways as to be without danger to other birds or to animals. The Massachusetts State Board of Agriculture does not approve of the offering of bounty for killing the sparrow; but, if a bounty for dead sparrows should be proposed, the Board believes that it should be limited to such sparrows only as are killed in the winter. It is found in Michigan, where a bounty is paid for the heads of dead sparrows, that many valuable insect-eating birds that are similar to the English sparrow in appearance are killed, and their heads palmed off upon unobserving officials. If the bounty was paid only for sparrows killed in winter, the insectivorous birds would be safe from the net of the bird-catchers.

The following preamble and resolution was unanimously accepted and adopted at the public winter meeting of the Board in Worcester in December last: —

*Whereas*, It has been clearly demonstrated, by post-mortem dissection and field observation, that most of the hawks and owls are highly beneficial to the farmer and fruit grower, we, members of the Massachusetts State Board of Agriculture and farmers assembled at Worcester, Dec. 2, 1890, —

*Resolve*, That, in our opinion, the birds of prey, or the hawks and owls, with rare exceptions, are of great benefit to the farmer and fruit grower, and should be protected. We respectfully urge our legislators to refrain from the passage of any law which will have for its object the destruction of these birds.

# THE PROMOTION OF AGRICULTURE.

BY FRANCIS H. APPLETON OF PEABODY.

It may prove interesting to briefly consider our subject in two directions, which at once suggest themselves, both retrospectively and as to some possibilities for the future. Let us first consider the former, and in so doing it will be interesting for us to view some of the advances brought about in organized agriculture within our own country, in connection with a few facts in regard to agricultural associations in other lands.

The first European agricultural society appears to be that founded in the north of Italy about 1705. We are told that its life was short.

Southern Europe was also early in establishing systematic education at a farm school in 1706, but the knowledge and methods there promulgated were undoubtedly crude and unsatisfactory; although we are told that, covering a period of about thirty years, three thousand peasants were instructed in the "higher systems of farming," which would seem, at least, to indicate the need and desire of those people for really higher agricultural knowledge, and probably some attractive method of offering what appeared to be something choice in that direction was adopted to attract so large a number of persons. In this case ignorance probably proved itself to be bliss, as advancement is reported to have been slight.

The year 1723 gave birth to the Society of Improvers in the Knowledge of Agriculture for Scotland, which was short lived, but revived in 1735 only for a second brief period.

The year 1731 saw the Dublin Society for the Improvement of Husbandry established; and in 1737 the Yorkshire Agricultural Society was organized, at whose exhibition in 1873 it was my pleasure to see a show of those superb

animals, whose careful and successful breeding must always delight a lover of good live stock, although he may not use the saddle for business or pleasure. The hunters there shown were an exponent of the kind of horse that has made a world-wide name for England in this class of animal; and whose pluck and spirit in its purity, or by judicious cross breeding, has carried British troopers, many a time, to victory.

In 1779 the Bath and West of England Society, which is now among their few societies of prominent value in agricultural progress, was founded.

In 1780 the oldest horticultural society in Europe is said to have been established. Probably it was the first in the world, but I can only quote this statement.

The year 1784 saw the birth of the Horticultural Society of London, whose methods and reputation are so high, and whose financial standing so liberal and strong, that the whole world must feel indebted to its founders for the horticultural advancement that it has spread abroad.

Also in 1784 was established the Highland and Agricultural Society of Scotland, the nucleus for which was the Highland Society, established the previous year. This society received from the government upon its organization ten thousand pounds (fifty thousand dollars). The publication of its well-known "Transactions" commenced in 1799. Its membership now exceeds five thousand persons. The broad and practical views and objects of its founders are well expressed in words as follows: —

*First.* — Agricultural meetings, with a general show of stock, implements, farm and dairy produce, to be held in the principal towns of Scotland.

*Second.* — Encouraging a system of district shows, for the improvements of breeds of stock most suitable for the different parts of the country.

*Third.* — The encouragement and promotion of a proper system of agriculture and forestry education.

*Fourth.* — For the advancement of the veterinary art, by conferring the society's certificate upon students qualified to practice.

*Fifth.* — The appointment of chemists in the science of agriculture.

*Sixth.* — The establishment of an agricultural museum.

*Seventh.* — The publication of reports and essays.

In 1785 the "Philadelphia Society for Promoting Agriculture" was formed, whose energy and usefulness has been great, and whose record will remain most honorable. The society appears to have lately transferred its library to the University of Pennsylvania, for the benefit of her agricultural department, and has transferred its work to other organized associations, after celebrating its centennial anniversary.

In 1790 a professorship of agriculture was established at Edinburgh, marking an important step in the advance in this line of knowledge.

In 1791 the Society for the Promotion of Agriculture, Arts and Manufactures was founded in New York State, and it, or its successor, appears to have been continued until 1819, when such was dissolved, and a State Board of Agriculture formed. In 1832 the present New York State Agricultural Society was formed, whose record for efficiency and usefulness is remarkably good. It is backed by an annual appropriation from the State, which enables it to devote its work to purely agricultural encouragement.

In 1792 the Massachusetts Society for Promoting Agriculture was established, and has been active in its work up to the present time, through nearly a century of existence; and it is to-day quietly but actively occupied.

Their early work was by spreading abroad the best information as to better methods of cultivation, of raising and securing seed, of breeding and purchase of live stock, of housing live stock, and of the feeding and care of same; stimulating the improvement of implements, live stock, etc., by invention and importation; and in as many ways as were suggested to advance the State's agriculture, by personal appeals, by lectures and writings, as their own and other publications of that day bear testimony.

They set the example to Massachusetts for the establishment of the county agricultural society system, which has more

recently developed so extensively; and withdrew from the field of holding fairs, when that work was no longer a necessity, but later gave material assistance in that direction to other societies, as such seemed advisable.

They have introduced into the State almost every kind of farm stock, encouraged its introduction from abroad, and promoted, by other means, the manufacture in the country of improved styles of commercial fertilizers.

More recently the trustees have been entrusted with the care and use of funds for special agricultural and health purposes, which have been used to promote the objects intended in as wise a manner as their judgment could suggest.

In 1792 was established in England that most useful, and, to this day, advanced and leading foundation, the London Veterinary College, whose course of study has been frequently sought by students from our United States. Veterinary science in this country should hold an advanced position in public estimation, and its promotion should receive all possible encouragement for the benefit of State and Nation. The appointment of veterinarians on battalion staffs in both regular army and militia would be a useful help in this direction, and lectures upon the breeding, care and feeding of horses in armory or at camp would be most useful. Veterinary science is found recognized in foreign armies. A veterinarian might be useful in connection with the work of the State Board of Health.

At the end of the Revolutionary war, when arms had been laid aside, we find Washington turning his attention to the study of such peaceful pursuits as would be valuable to his country. While studying methods of organization for the promotion and advancement of agriculture, he was led into considerable correspondence with Sir John Sinclair, which resulted in benefit to both England and her independent child in America. In 1805, coming recently from the presidential office, and having had acquaintance with Washington's agricultural experience, to add to his own discrimination and keen judgment, Hon. John Adams, but lately returned to Massachusetts, accepted the presidency of the Massachusetts Society for Promoting Agriculture;

and, together with that active writer and worker in the cause of Massachusetts agriculture, John Lowell, Esq., as secretary, accomplished much for the advancement of farming interests in this State. It was thus that Massachusetts agriculture received the aid of two most advanced workers to forward her cause; and records prove that they did it well.

While it has been shown that organized efforts to promote and advance agriculture were at that time making headway in this country, the same spirit was accomplishing like results in Great Britain, and in 1793 the British Board of Agriculture was established, through the efforts of Sir John Sinclair and others.

In 1795 the South Carolina Agricultural Society was incorporated, and I am told still exists.

In 1798 the famous Smithfield Club of London, well known to this day for its exhibits of superb specimens of live stock, chiefly beef cattle, was founded.

In 1838 that distinguished organization, the Royal Agricultural Society of England, commenced its admirable work. This organization was, and is, so thorough and complete, and its work so useful, that it commands from the men of England all money and effort that are from time to time necessary to make its regular work of the year and its very extensive annual exhibitions always most valuable and progressive. It is well ahead of any other agricultural society in the world for the completeness of all its work, and purity of its efforts for agricultural advancement.

The example set by this society is well worth presenting at this time, for the consideration of those who are unfamiliar with its organization and methods, and is here given, omitting that part which relates to its annual fairs and their list of prizes.

The present membership of the Royal Agricultural Society of England (June, 1890) consists of about eleven thousand persons. These may be divided into two classes, — annual and life; and each of these in turn is sub-divided into governors and members, but both these are entitled equally to all the special privileges offered by the society.

The annual members pay one pound (five dollars) yearly,

while the life members pay fifteen pounds (seventy-five dollars). The governors are those members who are not only able to pay a larger sum for the good cause of promoting agriculture, but who are patriotic and liberal enough to do so. An annual governor pays five pounds (twenty-five dollars) yearly, while a life governor pays fifty pounds (two hundred and fifty dollars). After payment of ten or more annual subscriptions, a member may compound for future subscriptions.

All members have privileges in the chemical, veterinary, entomological and botanical departments; in addition to which they have certain general privileges, as follows: Free admission to show yards, reduced rates for entry of live stock and implements, free copy of society's quarterly journal, and free access to library and reading-room. They also have the duties of attending the quarterly meetings, which are designated: annual, anniversary, show yard and the December.

The council or governing body consists of the president, twelve trustees, twelve vice-presidents, and fifty other members. The governors have the privileges of an extra copy of the journal, to attend and speak at all meetings of the council, and are alone eligible for election as president, trustee and vice-president.

The chemical department is applicable only to the case of persons who are not commercially engaged in the manufacture or sale of any substance sent for analysis. It is located in the city of London, in connection with the society's headquarters.

This society publishes, in all its journals, a guide to the purchase of artificial manures and feeding stuffs. This I will soon read, as it suggests methods and customs which are the results of long and careful experience.

I understand that all persons may employ the services of the society's departments, so far as those departments can attend to work outside of their own membership; but all members not only have precedence, but also have the services of the departments at prices considerably reduced from what would be charged to outsiders.

The tariff schedules, with directions, are published in all

the society's journals, so that correspondence in regard to the work of the departments is greatly facilitated and simplified.

It is surprising, but at the same time instructive, to an American, to learn the many cautionary measures taken by the English in managing their farming operations: in the preparations of the soil; the selection of pure fertilizers; the providing of manure enriched by good feeding; the choice of seed that is pure, fresh, and free from foreign germs; the choosing of the best-made implements for preparation and cultivation; and in harvesting at the time when the crop is thoroughly matured for their purpose. I refer to these points not that our own farmers may not be equally cautious, but as an introduction to a statement of the opportuniti esoffered by the Royal Society for making these cautionary measures effective.

## Guide to Opportunities Afforded by the Society.

### *Feeding Cakes.*

[How purchases should be made to protect the purchaser against impurities.]

1. *Linseed cake* should be purchased as "pure," and the insertion of this word on the invoice (or bill) should be insisted upon. The use of such words as "best," "genuine," etc., should be objected to by the purchaser.

2. *Rape cake for feeding purposes* should be guaranteed "pure," and purchased by sample.

3. *Decorticated cotton cake* (stripped of seed cover) should be guaranteed "pure," and purchased by sample.

4. *Undecorticated cotton cake* should be guaranteed "pure," and purchased by sample.

*N. B.* All feeding cakes should be purchased in good condition, and the guarantee of the vendor (seller) should be immediately checked by a fair sample (taken out of the middle of one of the cakes) being at once sent for examination to a competent analytical chemist. The remainder of the cake from which the sample sent for examination had been taken should be sealed up in the presence of a witness, and retained by the purchaser for reference in case of dispute.

*Artificial Manures.*

1. *Raw or green bones or bone-dust* should be purchased as "pure." Raw bones guaranteed to contain forty-five to forty-eight per cent of tribasic phosphate of lime, and to yield not less than four per cent of ammonia.

2. *Boiled bones* should be purchased as "pure." Boiled bones guaranteed to contain from fifty-five to sixty per cent of tribasic phosphate of lime, and to yield not less than one per cent of ammonia.

3. *Dissolved bones* are made of various qualities, and are sold at various prices per ton; therefore the quality should be guaranteed under the heads of *soluble* phosphate of lime, *insoluble* phosphate of lime, and nitrogen, or its equivalent as ammonia. The purchaser should also stipulate for an allowance for each unit per cent which the dissolved bones should be found on analysis to contain less than the guaranteed percentages of the three substances already mentioned.

4. *Mineral superphosphates* should be guaranteed to be delivered in a sufficiently dry and powdery condition, and to contain a certain percentage of *soluble* phosphate of lime, at a certain price per unit per cent, no value to be attached to *insoluble* phosphates.

5. *Compound artificial manures* should be purchased in the same manner and with the same guarantees as dissolved bones.

6. *Nitrate of soda* should be guaranteed by the vendor to contain ninety-five per cent of pure nitrate.

7. *Sulphate of ammonia* should be guaranteed by the vendor to contain not less than twenty-four per cent of ammonia.

8. *Peruvian guano* should be sold under that name, and guaranteed to be in a dry and friable condition, and to contain a certain percentage of ammonia.

*N. B.* Artificial manures should be guaranteed to be in a sufficiently dry and powdery condition to admit of distribution by the drill. A sample for analysis should be taken, not later than three days after delivery, by emptying several bags, mixing the contents together, and filling two tins hold-

ing about half a pound each, in the presence of a witness. Both the tins should be sealed; one kept by the purchaser for reference in case of dispute, and the other forwarded to a competent analytical chemist for examination.

*In the Veterinary Department.*

1. Members of the society have all the privileges of subscribers to the Royal Veterinary College, so far as the admission for treatment of cattle, sheep and swine is concerned, without being called upon to pay the annual subscription to the college of two guineas ($10.50). The charges made by the college for keep and treatment are as follows: cattle, 10*s.* 6*d.* ($2.62½); sheep and pigs, 3*s.* 6*d.* ($0.87½) per week for each animal.

2. The full privileges of subscribers, including the examination of horses, and the admission of horses and dogs into the college infirmary for surgical or medical treatment, on payment of the cost of keep, will be accorded to members of the society on payment of a subscription to the college of one guinea instead of two guineas per annum.

A schedule of prices is given for consultation analyses, and examinations at the Veterinary College, and for investigation of outbreaks of diseases among farm stock. The member will be relieved from payment of fee if the outbreak proves to be of an important character, or of general interest. Members of the Royal Agricultural Society are requested to send to the Veterinary College any diseased animals (cattle, sheep or swine) which they would otherwise destroy as useless, and also any diseased parts of an unusual character.

A list of "provincial veterinary surgeons" is published in the journals, who are recommended by the society, but with whom the members must arrange as to payment of fees. ("Provincial" here means living in different districts of England.)

In the entomological department, the charge is fixed, for members, at 2*s.* 6*d.* ($0.62½) for the determination of the species of any insect, worm or other animal, which, in any stage of its life, injuriously affects farm crops, with a report on its habits, and suggestions as to the methods of prevention and remedy.

*In the Botanical Department.*

1. A report on the purity, amount and nature of foreign materials, the perfectness and germinating power of a sample of seed: 1*s*. ($0.25).

2. Determination of the species of any weed or other plant or of any epiphyte (air plant) or vegetable parasite, with a report on its habits, and the means of extermination or prevention: 1*s*. ($0.25).

3. Report on any disease affecting farm crops: 1*s*. ($0 25).

4. Determination of the species of a collection of natural grasses found in any district, with a report on their habits and pasture value: 5*s*. ($1.25).

*N. B.* The consulting botanist's reports on seeds are furnished to enable members, purchasers of seeds and corn for agricultural or horticultural purposes, to test the value of what they buy, and are not to be used or made available for advertising or trade purposes.

The Royal Society publishes these directions for the instruction of those purchasing seeds: that the purchaser should obtain from the vendor, by invoice (bill) or otherwise, a proper designation of the seed he buys, with a guarantee that it contains not more than a specified amount of other seeds, and is free from ergot (seed diseased by influence of parasitic fungus), or, in the case of clovers, from dodder (a parasitical plant), and of the percentage of seeds that will germinate. The germination of cereals, green crops, clovers and timothy grass, should be not less than ninety per cent; of foxtail, not less than sixty per cent; of other grasses, not less than seventy per cent. The Royal Society publicly announces that the purchase of mixtures of grass seeds should be avoided, and that the different seeds to be sown should be purchased separately. The advisability of this method is, I believe, well known to agriculturists in this country.

The Royal Society's library is well stocked with standard books on agricultural subjects, and the reading room contains the principal agricultural newspapers and other periodicals.

The Royal Society holds examinations to test the qualification of individuals in the following-named subjects, and gives suitable rewards or certificates for successful passing of the same. They are divided into senior and junior.

The latest list of examination papers at my command is for 1889, and these are given as a sample: —

Senior Examinations, 1889.

I. Examination in agriculture, written and oral.
II. Examination in book-keeping, neatness and rapidity of working considered.
III. Examination in chemistry: *a*, general chemistry; *b*, agricultural chemistry.
IV. Examination in mensuration and land surveying.
V. Examination in agricultural engineering.
VI. Examination in botany.
VII. Examination in geology.
VIII. Examination in anatomy and physiology.

Junior Examinations, 1889.

I. Examination in agriculture.
II. Examination in elementary chemistry.
III. Examination in mechanics and natural philosophy.
IV. Examination in mensuration and land surveying.

I have stated at some length those characteristics of the Royal Society of England, for which it commands the respect, and interest in its welfare, of everyone who knows about its work, which is strictly and purely agricultural, in the most advanced sense; and I desire to have our agriculturists thus become familiar with its system of work.

It has set an example, which has been approved and followed by the New York State Agricultural Society, in its system of fairs, and, to a more limited extent, otherwise. It has been the aim of the Bay State Agricultural Society to also adopt its system of fairs, at the three exhibitions which it has held, so far as its facilities and opportunities have allowed. There is, of course, a greater liability to financial loss in such a fair, where agricultural exhibits are solely relied upon to draw admission payments, and other methods are not adopted as an offset to a possibility of loss; but the State of New York recognizes their value, and makes an

annual donation of about $17,000 a year to her society. Certainly there is something suggestive in the statement.

Recognizing the value of a purely agricultural show, the trustees of the funds entrusted to the Massachusetts Society for Promoting Agriculture (the organization which, I have said, nearly a century ago began to encourage the promotion of Massachusetts agriculture, and the improvement of her stock) have twice guaranteed the Bay State Society's prize list of $10,000; and for its other Fair the guarantee was provided by local interest, supplemented by voluntary subscriptions from many members of the society.

With whatever were their short-comings, or their merits, and they both must have existed, the two fairs at Boston and one at Springfield have received much praise.

In 1892 the Massachusetts Society for Promoting Agriculture will round out a century of successful existence, and proposes to suitably celebrate that event. Whether that event shall be celebrated, and, if so, how it shall be done, remains as yet undecided.

As she was instrumental in the formation of our original county agricultural societies, and set an example by holding fairs of her own, until the successful establishment of the former made her own fairs superfluous, when she withdrew from that field of usefulness, it would seem eminently proper that an extended account of her work during the century should find place here, but that can be reserved for 1892.

Myself a believer in the value to a State of extensive, purely agricultural fairs, where specimens of the best live stock and best agricultural products can be seen, I hope that such may be continued in this State at proper intervals. They help the State in two particular ways: *directly* by benefiting the producer and tending to his advancement, and *indirectly* by educating the consumers to appreciate the value to them of intrinsically better articles, and training such consumers to be willing to pay fairly for those articles.

The Massachusetts Charitable Mechanics' Association, after endeavoring to support annual exhibits, some years ago decided to hold their fairs triennially, and have met with great success.

Their fair of 1890, which continued in Boston for about two months, profited them to the extent of $60,000.

Can we not in Massachusetts succeed in preserving a State agricultural exhibition of live stock, produce, etc., by adopting the triennial system of the Charitable Mechanics' Association, in some form that shall unite all agricultural interests in the State in one triennial fair, based on purely agricultural principles? It would seem that this suggestion might be developed into such a success that breeders and producers would regularly vie to secure all available space, to such an extent that our best hopes would be realized. Could the State afford to *guarantee* against loss to the amount of $10,000, if not *donate* that amount triennially?

In New York State the annual appropriation to the State Agricultural Society is, as I have said, near $17,000; but that includes a requirement for work which is here largely placed under the direction of our State Board of Agriculture, by its power over the annual bounty to agricultural societies.

Can this Board formulate rules to so direct the use of that bounty as to bring about more benefit to the State's agriculture than is now the case; and do any of the societies' annual printed reports, or "transactions," give us any evidence to suggest the possibility of such action doing good?

There are practical difficulties in the way of keeping our older county societies up to our ideal standard, as we all know; and much less can we expect to reach that standard at the fairs of the smaller societies. But it is desirable to preserve these annual meetings, and the local management must be responsible for the methods employed without undue interference from outside. We must all recognize the value that pure and complete agricultural fairs, aiming for the improvement of agriculture and her products, can be to the State, if held in the best location, with regularity as to time; and all county and local societies could well occasionally join in making a State fair a grand success. It must prove of as much value to all our local agricultural societies to have an extensive and purely agricultural fair at proper intervals in the State, as it is to our educational system to have in existence the invaluable assistance of our normal schools. Both are educational

The organization which shall be best able to conduct such a fair should have the full respect of all our local societies, and be able to depend upon their fair share of co-operation in providing a sufficient quantity of entries to largely fill the several departments at such an exhibition. The premium list should be open to all parts of the country, in order that the best should be sought wherever it may exist, in order that the State might either learn better, or show off her supremacy. Assured of such support, the direct and best management to bring about the most successful results should be as independent, but as responsible, as possible. In the large Western fairs, the management is often lodged in the person of a single individual.

It is understood that this Board meets, under direction of the statutes, to *exchange ideas*, and to *consult*, among other duties, as to how we can best act collectively, and through our own societies individually, for the advancement of our Commonwealth's agricultural prosperity, and to sustain her agricultural institutions in advancing knowledge in this same direction.

It is my endeavor not so much to attempt to tell an intelligent body of men, representative of all parts of the State, what I think they should do, — for I should not presume to that, — but to give this deliberative body a target at which to aim some of their remarks, in the hope that good results may be reached, by our concluding to adopt ways, if such exist, by which we can make advances in our system. Encouraging and aiding the work of our local societies should be the basis for such action as may be decided upon.

I have already referred to the annual "transactions" of the agricultural societies, and briefly return to that subject. Public Statutes, chapter 114, section 5, contains this: —

"Every such society [receiving bounty] shall annually, on or before the tenth day of January, make a full return of its doings, . . . [stating several well-known requirements]; including all reports of committees, and all statements of experiments and cultivation, regarded by the president and secretary as worthy of publication, and with such general

observations concerning the state of *agriculture* and *manufactures* in the Commonwealth as it may deem useful. The return shall be marked in such manner that the passages deemed by such officers most worthy of public notice, study and application, may be easily distinguished."

Then follows a very important clause, which must be familiar to us all, in regard to the forfeiture of bounty for non-compliance with the laws relating thereto.

Very few societies appear, from their transactions, to now comply fully with the spirit of all the suggestions, although they seem to satisfy the law. These laws were framed before experiment stations were established; and as the requirements, which have been just quoted, include committee reports, and statements of experiments and cultivation, it would seem that this work, which has so generally, and with a few exceptions, apparently, fallen into disuse, might have new life and usefulness infused into it, by transferring such work to the experiment department of the college, where the experimenting is done. The agricultural societies would then co-operate upon well-defined plans with said experiment department, in this line of work. This would seem to be a matter of considerable importance, and one which should be carefully considered; possibly by a joint committee from this Board, and from the college trustees, in order that, if advisable, a suitable bill may be framed, and introduced into the Legislature to accomplish this.

In Public Statutes, chapter 31, section 17, we find a provision for a "Board of Supervisors of Statistics," as follows: —

"The secretary of the Commonwealth, the secretaries of the boards of agriculture, of education, and of the State board of health, lunacy and charity [health undoubtedly intended, but title not here altered to conform to new law], and the chief of the bureau of statistics of labor, shall constitute a board of supervisors of statistics, who shall serve without pay."

This is superfluous now that the Bureau of Statistics is in existence; but cannot meetings of the secretaries of the boards of agriculture, education and health be held, to the advantage of each of these boards? Certainly this Board

is educational in its agricultural work, and was formed to do all that was possible in that direction; consequently it might gain and give valuable additional force to and from its work, by consultation with the educational department, and certainly the work of the health department is most closely allied to the other two boards.

The condition and needs of our agricultural population could thus be more intelligently understood, from such consultations as are here suggested, and the welfare of a large part of our citizens probably benefited.

At the recent teachers' meeting in Boston, the superintendent of Chicago public schools in his address argued "that the public school rests upon the inalienable right of childhood to an education suited to its surroundings. The child has a claim on the State, which should cultivate the intellect of its children." He went on to point out evils in the present systems, and their remedies.

I will add that there are students of these subjects who believe that ours, which was formerly the leading educational system, has been so built upon in other younger States, in forming their systems, that Massachusetts should now carefully investigate the systems of other States and countries, with a view to learning any improved methods and ensuring her children's education best suited to their future wants and happiness.

It is understood that the reference applied more to the rural than city schools.

# CARE AND MANAGEMENT OF MILCH COWS.

BY GEO. L. CLEMENCE OF SOUTHBRIDGE.

The milch cow is the basis of New England agriculture. She is the essential factor by means of which the farmer is enabled to convert the products of his fields and meadows into an available commodity of exchange, and in addition she furnishes, to a very material extent, those elements which enable him to carry on his farm operations and maintain the fertility of his lands. She is the delicate, living mechanism by which we seek above all things else to perpetuate and make profitable a New England rural economy. The occupation and cultivation of the broad and cheap areas in the West preclude the possibility of producing in Massachusetts beef and the more important cereals, at a profit. Fortunately the growth of population in cities and towns has created an ever-enlarging market for those products of our farms which do not come into so direct competition with the production of the inexpensive and virgin acres of the West, as would the less perishable products.

To-day milk is the staple article produced upon the farms of Massachusetts; and, whether this is sold whole or in the form of cream or butter, the great majority of farmers are dependent upon it for whatever measure of success they secure in their calling. To obtain the greatest amount of this, of a standard quality, and at the least possible expense, is the aim of the dairy farmer. To this end he directs his thoughts and efforts, and, realizing that dairy or milk farming will not permit of that freedom or indifference possible in stock or grain raising, he looks more carefully and with a greater diligence to the farm and its buildings, and to the cultivation of his fields. He ploughs and manures, sows his

seed, cultivates and harvests his crops for this single purpose, and the culmination of it all is with the dairy cow. No matter how diligently he may have toiled, no matter how rich and succulent has been the feed in his pastures, or how bountiful his crop of hay, upon her capacity or power to convert her food into milk, and the products made therefrom, depends the measure of his reward. Recognizing this, how essential it is that her owner should direct his best efforts and energies to her care and management.

The subject assigned me is of a two-fold nature, for the milch cow may be one kept particularly either for milk or for butter. The care and management are essentially the same, but their breeding may be on a different line. It is as a milk producer alone that I shall speak to you on this occasion, for as such has been my entire experience.

From the time when I first embarked as a farmer, some eighteen years ago, down to the present, my energies and my farm have been directed to the production of milk of a quality satisfactory to my customers, and in quantity sufficient to pay me better by selling it whole than by converting it into butter. The location of my farm, but a mile or so from a busy manufacturing town of seven thousand inhabitants, made it possible and desirable that I should, in the very beginning of my farm life, adopt this course; and I have seen my permanent stock increase from twelve head to forty head, maintained from the same number of tillable acres that I possessed at the beginning of my farming career.

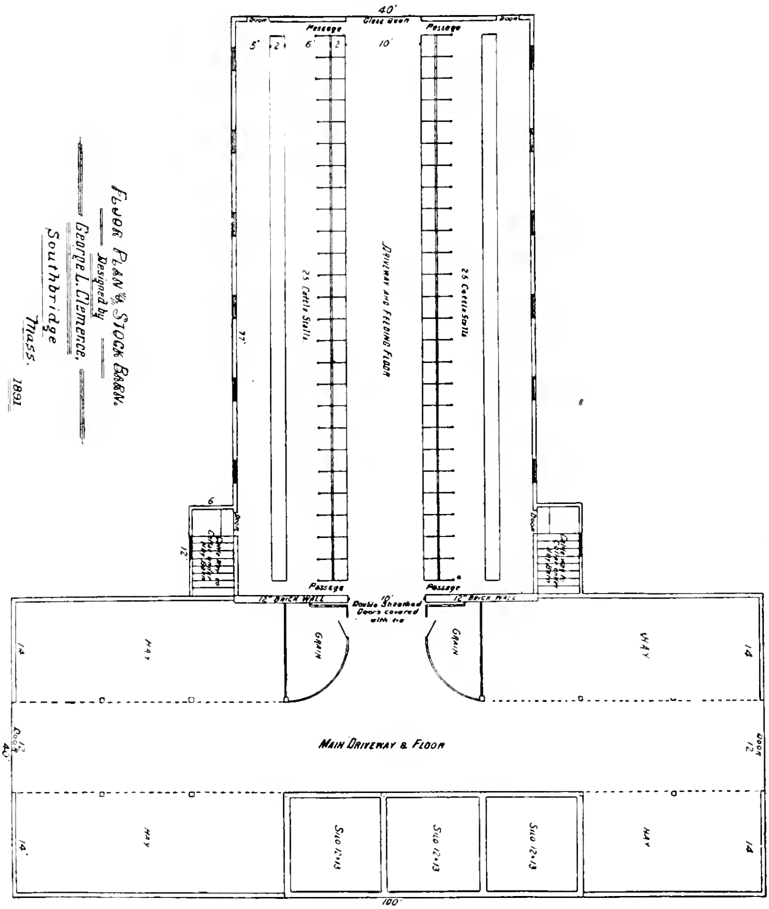
From the outset to the present time it has been my aim to breed and raise my own cows. Occasionally I have bought promiscuously, to tide over a temporary deficiency in my supply of milk, and again I have bought now and then a cow in which I saw promise of a superior milker; but, as a whole, my herd has consisted of stock bred and reared by myself. I believe this course has been of continuous and permanent advantage to me. By this method I have known, to a far greater degree, the nature, characteristics, temperament and predispositions of my cows than would have been the case had I replenished my herd by purchases, as the cows themselves are thoroughly at home, and are accustomed from birth to their surroundings. I know that with the farmers

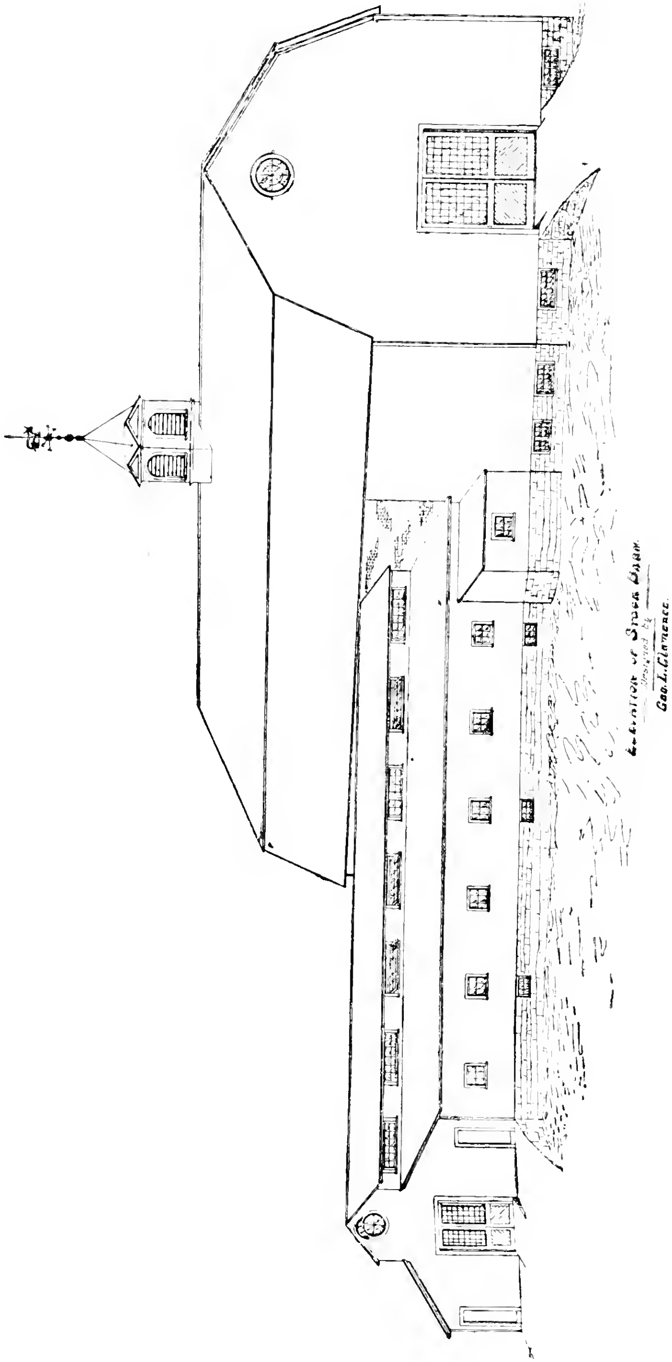
living near a large city this custom may not be practicable, for it presupposes the possession of cheap, outlying pastures, where the young stock can be fed in the summer months.

The ideal cow for a milk farm is, in my opinion, a grade. I do not believe that any one breed possesses so many good points as two or three breeds combined. I keep a pure-bred sire, alternating, as nearly as practicable, every three years, with one of a different breed. To illustrate, if I were starting a herd, I would keep a Shorthorn bull of a well-established milk strain; during the second three years I would keep an Ayrshire; and in the third three years I would keep a Jersey. From the Shorthorn sire would come size, and capacity to eat and digest a large amount of feed; from the Ayrshire I secure a predisposition to a large yield of milk, and a cow peculiarly adapted to our hilly and rocky pastures and their short feed; from the Jersey would come the requisite richness and solidity of the milk. I have never kept a pure-bred Devon or Holstein sire; still, I would not hesitate to take a Devon, instead of a Jersey, because of the richness of their milk, their rugged constitution and their adaptability to our climate and lands. Neither would I object to a Guernsey; and, if my milk tested well above the legal standard, I might possibly be induced to use a Holstein.

In breeding, I aim to secure as large a cow as possible, and retain the milk form and characteristics. The larger the cow, the more she can eat; and the more she eats, the more milk will she produce. A small cow with small digestive capacity cannot, in the nature of things, make so much milk as a larger cow with a greater digestive capacity. This on the supposition that both are proportionately equal in a milk-yielding point of view.

The milch cow should have a warm, clean and wholesome stable, well lighted and well ventilated; and I have come to the conclusion that it is a wise economy that this stable should be separated from the main barn, and constructed with especial reference to her welfare and convenience. I believe this plan has much to commend it. Its construction we can so plan as to economize in the labor of feeding; secure far greater safety from danger of loss of cattle from fire; provide more light and better ventilation; and can


Floor Plan of Stock Barn.
Designed by
George L. Clemence,
Southbridge
Mass.
1891
Driveway and Feeding Floor
25 Cattle Stalls
25 Cattle Stalls
Passage
Passage
12" Brick Wall
12" Brick Wall
Double Sheathed Doors covered with tin
Grain
Grain
Hay
Hay
Hay
Hay
Main Driveway & Floor
Silo 12×13
Silo 12×13
Silo 12×13
40'
100'


Elevation of Stock Barn.
Designed by
Geo. L. Clemence.

keep our hay from becoming permeated with the breath of the cattle and the odor of the manure in the barn cellar. To prove my faith in this doctrine, I will say that I have already begun the construction of a stock barn; and, that you may the better understand my proposed work, I have prepared a plan for your inspection.

You will observe that my barn stands east and west. Now, my proposed cow barn will extend southward from the centre, and at a right angle with the main barn. It will be joined to the barn with a brick partition between, and the door leading from one to the other will be of iron. In the case of fire in the main barn, with this arrangement the possibilities of saving my cattle are greatly enhanced, and the chances of the main structure catching on fire are far greater than of the stock barn. The new building will be seventy-five by forty feet in dimensions, with eight-foot posts and monitor roof. The last will have windows its entire length, and the distance between these will be only the width of the casing. The superstructure will be also liberally furnished with windows. At the south end will be a door of ample width to allow the passing of a two-horse team. The iron door will be of the same width, and thus you will perceive that I can drive over the floor of the main barn and into the cow stable. It will have a cellar under the whole, and passageways will lead from near the angles formed by the barn and stable to the cellar below the former. Here the cows can drink and exercise in the winter season.

Another essential to the care and management of dairy stock is the furnishing of a supply of pure water. It is my custom to water my cows twice a day in cold weather, and the water is always warmed to the temperature of eighty to eighty-five degrees. That warm water is desirable and every way better for cows than that usually given them, is no guess-work on my part, for I have learned it by actual and repeated tests. I have raised and lowered my supply of milk by changing from one to the other. I warm the water in the watering trough by means of a pipe running from the steam heater in my residence to the barn cellar and the trough; but, were I without this convenient means of warming the water, I would carry hot water from the house,

before I would have my cows drink it ice cold. It should be borne in mind, always, that the milch cow as we find her to-day is to a large extent an artificial production, so far as her milk-producing abilities are concerned. It has been careful management and skillful breeding that have brought her to the present standard. By long-continued breeding, her milk-yielding qualities have become fixed, and she has the power to transmit these qualities to her offspring. Yet, remembering that they are largely artificial, it is the part of wisdom for us to exercise the utmost care that nothing occurs to injure this living piece of machinery that is so susceptible to an unnatural influence. I can scarcely realize anything that is so deserving of criticism as the turning out of cows into an open yard in the winter season, to drink from a tub or trough in which the ice must first be broken.

Again, it has always been my custom to give my cows a daily carding, hence no man has ever seen on one of my herd a particle of dirt or manure that had been there for a longer time than twenty-four hours. Of course this carding is done only after the cows have come into their winter quarters. I am well satisfied that this work pays, and would believe it if nothing else was accomplished than the keeping the cows clean. But I believe my cows like their morning toilet, and that the operation has a good effect on both their disposition and temper. Cleanliness is an attribute of almost every animal, but particularly is this characteristic inherent in cows. Cleanliness should be carefully observed as every point in and around the barn, for the susceptibility of milk to become impregnated with objectionable odors is known to every farmer.

While every feature in the care and management of the milch cow is an essential one in itself, that of feeding is all-important, and calls into play care, intelligence, skill and discretion. The physical structure of a cow is such as to require a larger amount of feed in proportion to her size than other neat stock. She not only eats to maintain her physical being and strength, but also to secrete matter that is transformed into milk. A cow cannot produce milk unless she has been fed a sufficient quantity of milk-producing feed. Feed of the same kind varies in its nutritive qualities under

different conditions and circumstances. Hay made from grass grown upon impoverished land has not, in a given weight, the same amount of milk-making elements as that grown upon land rich with the elements of plant food. The deficiency which exists must be made up by a greater amount of more concentrated feed, if like yields of milk are to be secured. Naturally, then, the dairy or milk farmer seeks to secure the greatest possible amount from a given area, and of the highest possible feeding quality. The two go together. A ton of hay gathered from a third of an acre has more of the elements of animal growth than has a ton raised upon an entire acre, — provided, of course, both are of the same variety, and harvested under like conditions. The very fact that one acre has been able to produce only one ton to the other's three, is evidence in itself that it is lacking in the elements of plant and animal growth. In practice, the feeding should be done as near stated intervals as possible, and each cow's individual wants and capacity should be supplied as far as practicable.

In grass, grown on land supplied with every requisite for its development, we have a perfect food for cows; so I believe that in the winter season we should come as near to this as we can. Grass is succulent and juicy, so in the winter season we should aim to furnish them with a food as nearly like it as possible. I know of nothing so convenient and so satisfactory in every particular as well-grown and well-kept ensilage, and this verdict I give after an experience of ten years in its feeding. I was one of the first in the State to build a silo and feed ensilage, and I have never for an instant regretted my doing so, or had occasion, after my first season's experience, to doubt its efficiency as a desirable feed for milch cows. I raise Stowell's Evergreen sweet corn exclusively, and harvest it when the ears are in the best condition for table use, cutting up ears and stalks for the silo. I feed ensilage twice a day, morning and night, and each time immediately after milking. I give on an average to each cow fifteen pounds at a feed, which measures one-half bushel. Of hay I feed twice a day, giving to each cow what she will readily eat up clean. Of concentrated foods my general practice is to give linseed meal and bran,

giving to each cow one quart of linseed meal and two quarts of bran at a feed, twice a day. This is varied more or less as the condition and demand of each cow may require; these concentrated foods are always fed with the ensilage. On good pasturing, cows will produce more milk at a less cost than on any other feed; but our pasture grasses fail in their nutritive elements about the middle of July, even in a favorable season, and then it is policy for us to feed a quantity of green barley or oats, to be followed in August by sweet corn fodder, which carries us well towards the last of September, when we have cabbages and late-sown barley. Cabbage as a feed for milch cows I highly esteem, and, after fifteen years' experience in feeding them, I have yet to see the first deleterious effect, or to hear the first complaint of their tainting the milk. These I always feed directly after milking, whether morning or night. The cows relish them, and they increase the yield of milk so perceptibly that at a market price of eight dollars a ton I would rather feed them out than take them to market.

In any considerable herd of cows there will be found every now and then one not up to the standard in the quantity of milk she gives. A watch should be kept for such, and, if the shortage appears to be permanent, they should be prepared for the butcher; for it does not pay to keep a cow that does not give a profit on her milk. In every herd also is likely to be found one cow that gives a larger quantity of milk than any one of the others. If this is a well-balanced milk that is up to the legal standard, then it is well for you to make her your ideal for the time at least, and raise her female progeny. I have had such cows from time to time, and the majority of my herd at present consists of cows descended from some special ideal. I have in my herd to-day a cow that is superior to any other I have ever owned, and I have for many years considered myself fortunate in the high character of the cows constituting my herd. This cow is now in her ten-year-old form, and is a grade; her sire was a pure-bred Jersey, her dam a grade Shorthorn, and noted for her great quantity of poor milk. This cow is not of my own breeding, but was bred in the adjoining town of Dudley. It was not until she had reached her seven-year-

old form that she demonstrated her superiority as a milk-producing cow, and at that time she was sold to a person in my own town of Southbridge. Under his care she began at once to increase on her previous quantity of milk, until her yield reached a point that was remarkable. At this time she was a family cow; that is, she was the only one in the possession of the owner, and was kept to supply his family with milk. She had the best of care, the best of feed, and all she wanted to eat; and all this we should and must do for each and all of our cows, to reap success.

From time to time I saw this cow and her unusual yield of milk, and I thought I would like very much to become her owner, and this wish I realized the first of last April. She calved on the 7th of April, and, as she had not been in the company of other cows for the previous three years, I concluded to keep her by herself until she became familiarized with her new surroundings. Under my care she surpassed her previous milk record, giving, from May 12 to January 12 of this year, 10,807 pounds and 11 ounces, — an average of 45 pounds a day. From May 18 to June 7 inclusive, a period of twenty days, her yield was 1,403 pounds and 12 ounces, — an average daily production of 33 quarts. During these twenty days and up to the 20th of July she was milked three times a day. Her feed was the best of pasturing, together with two quarts of clear corn meal and four quarts of bran. Large and gratifying as was her yield of milk, it was no less remarkable for its richness. A trial test, comprising her milk of three consecutive days, commencing June 1, gave an exact 9 pounds of unsalted butter, — an average of 3 pounds a day, or 1 pound of butter from 23 pounds of milk. This, you will remember, was in June, when a relatively larger quantity of milk is required for a pound of butter than is the case later in the season. A previous butter test, made by her preceding owner in the September prior to my purchase, showed that it required only 15 pounds of her milk to make 1 pound of butter. Her milk record for the two years preceding my ownership of her was for 1888 10,591 pounds and 7 ounces, — an average daily yield of 29 pounds, or 13½ quarts per day for the year. Her total production of milk in 1889 was

9,856 pounds and 14 ounces, — an average of 27 pounds per day for the year. The dairy commissioner of Iowa is reported as saying that the average cow in that State gives but 3,000 pounds of milk annually. Statistics show that in the State of New York, with its 1,500,000 milch cows, they produce on an average less than 3,000 pounds of milk per year; while this cow has given an average of more than 7,000 pounds per year — more than the average cow — for the past three years. During these three years whose record I have given she dropped a calf every year.

During the two years prior to my purchase she had the best of pasturing, one and a half quarts of corn meal and three quarts of bran, and in the winter the pasturing was supplemented with the best of hay and rowen. A fact in connection with this cow is that she is not only the greatest milker in my herd, but she is also the greatest eater. Thus it is that her value as a milch cow lies in her ability to convert a large amount of fodder into a large amount of milk, and this milk is rich in solids and fats. I have stated that it was not until she had come into her seven-year-old form that she gave indications of being a superior milker, neither did this happen until she had changed owners. Now, the query with me is, did not this cow possess the ability to yield as much milk prior to as she did after becoming the property of another owner, but did not for the simple reason that her owner through ignorance failed to give her enough to eat? If this latent development was hereditary, she most assuredly has transmitted this trait to one at least of her offspring, a two-year-old heifer, which I had the good fortune to buy when it was a calf. This heifer calved some eight months ago, and is now giving 25 pounds of milk a day. I believe she bids fair to make even as good a cow as her dam I also own two more of her heifers, and by these statements you will perceive that I propose to make her progeny the basis of my future herd.

The sanitary conditions of our barns and stables and the health of our cows should be zealously looked to. As already said, the water should be pure and clean, and their food substantial and wholesome. No cow showing the germs of disease, however latent these may be, should be retained

for a moment. I have found it economy to have my herd examined by a veterinary surgeon of acknowledged skill, and, on his declaration that my herd was free from disease, have obtained from him the following certificate, which I had indorsed by the Board of Health of my town: —

CERTIFICATE.

SOUTHBRIDGE, MASS, April 14, 1890.

This may certify that I have, at the request of George L. Clemence, examined his herd of cows, and do not find any traces of the disease knows as tuberculosis (or consumption), therefore pronounce them perfectly healthy. Furthermore, I would add that it is very seldom that I find stables so clean and the sanitary surroundings so well adapted for the making of wholesome milk as in this.

E. C. VINTON, V. S.

SOUTHBRIDGE, April 14, 1890.

Having examined the certificate of Dr. E. C. Vinton, in reference to the condition of the dairy of George L. Clemence, we, the Board of Health of the town of Southbridge, indorse the same, and recommend the product of his dairy as wholesome, and fit for use.

C. C. BRADFORD.
J. A. GENEREUX.
F. H. OLIN.

I next gave a copy of the certificate and indorsement to each of my customers. The satisfaction one gets from setting at rest the fears of customers amply repays all expense and trouble, to say nothing of your own satisfaction that your herd is all right. Let me say a word on the care and disposal of milk, for, if this is not of our subject, it is pertinent to it. Have a milk room, if possible, entirely separate from every other apartment, and allow nothing to be kept in it but milk and its receptacles. I need not say anything here of the necessity and wisdom of taking the milk from the barn with the least possible delay, for upon that point we are all agreed; but let me speak of the desirability of thoroughly aerating the milk. By this process we remove from the milk its animal heat and the volatile odors. The mechanical contrivance for the accom-

plishment of this work consists of a circular tank or cylinder of from one hundred to one hundred and fifty quarts capacity. In this is placed a close-covered tin vessel, so made that it gradually contracts from the base to the top, that it may always keep right side up. In fact, it resembles very much the contracted top of a milk can. This tin vessel is filled with ice. Above the can and hanging from the ceiling is a tin pail with a slightly flanging top, and large enough to easily hold a strainer pail of milk. Near the outer circle of the bottom of this pail is a single — or it may be double — row of perforations. As the milk falls upon the vessel filled with ice in the milk tank, its animal heat and odors are at once given off, and after a few minutes the milk becomes as cold as if it had stood for several hours. The entire peddling rig should be kept neat, clean and attractive, for in this case appearances tell. Strive also to have your route as concentrated as possible, as a mill saved in the expense of disposing of a quart of milk makes a fine aggregate on a hundred quarts at the end of a year. Nothing will help you so early to get a convenient and concentrated route as having the reputation of selling a clean article.

The inevitable tendency of milk and dairy farming is toward a concentration of efforts, or, in another meaning, to an intensive agriculture. If there is a demand for more than your existing quantity of milk, and you are anxious to supply the demand, try first to get the requisite feed required for another cow from your present acres instead of buying more land. Keep your existing land better enriched and in better tilth, and you will be enabled to keep another cow.

I have upon my farm a bone mill, in which I have annually made for the past eight years four tons of ground bone. I do this with a six-horse-power boiler, a steaming tank of fifteen hundred pounds capacity, and a grinding machine. I pay fifteen dollars a ton for the raw bones, and it costs me seven dollars a ton to fit them for the land, or a total of twenty-two dollars for an article absolutely pure. I apply some ten hundred of this to an acre at the time of seeding. I have now been all over my tillable land with this, and it

has brought in the clover and other rich forage plants, and my cows have had that to eat which is rich with those elements that go to make bone and muscle and rich milk in generous quantities. Outside my barn I have a cistern with a liquid measure capacity of two hundred and forty barrels. From under the line where my cows stand, a trough leads to the cistern. The liquid contents of this reservoir I sprinkle over my land with a wagon fashioned after the manner of a sprinkling cart. I believe this investment will pay handsomely, for I have faith to believe it will increase the productiveness of my land; and it is faith, supplemented with work, that makes farming in Massachusetts pay equally as well as anywhere else in this country.

Mr. Clemence's essay was discussed by several members of the Board. Mr. Newhall of Conway gave his experience in the warming of water for cows, which confirmed the views expressed in the essay. Mr. Bowditch of Framingham stated that his herd of twenty cows had given two hundred pounds of milk extra per week after using water warmed up to eighty to ninety degrees, and the increase in butter yield was in like proportion. President Goodell stated that the results of careful experiments by Professor Alvord of the Maryland Experiment Station, formerly of the Massachusetts Agricultural College, showed the same results as those from Mr. Bowditch's experience.

# THE FARMER; HIS RELATIONS TO THE MANUFACTURER AND MECHANIC.

BY J. G. AVERY OF SPENCER.

The farmer, manufacturer and mechanic, — a trio, — the embodiment of all our manual and mechanical labor industries; each dependent upon the other. The manufacturer and mechanic are dependent upon the products of the farmer for the sustenance of life, and every cycle of the sun calls for a fresh supply. The farmer is assured of a continuous demand. His risk is limited to climatic causes, he is seldom overstocked, and he can always find a demand for his products somewhere at a price. The manufacturer of domestic articles which are for use in every-day life finds a ready sale. If competition is sharp, his margin of profit is small. There are many manufacturers who are subject to the whims and caprices of fashion. Some are made millionaires, and more are made bankrupts. The mechanic is always busy studying the wants and necessities of the manufacturer and farmer. If he can see wherein their machines can be improved, be it a plough or a loom, he is on the alert to work out the problem. His tools are as a rule the best that can be made, and are kept in order. His aim or purpose is to accomplish a certain object, and, if successful, he is sure of his reward. The farmer criticises the manufacturer and the mechanic, and the mechanic criticises both the manufacturer and the farmer, and there is no law to prevent it. Neither would have this blessed privilege suppressed if they could.

The oft-repeated remark, that the agricultural industry is the key-stone to all our greatness, is as true to-day as it was a hundred years ago. If any one can be found that doubts the saying, let him take a trip to the west, north-west and

south-west, and witness the developing of our agricultural industries. Look at the cities of the great west, which have grown to such prominence that it excites the envy of the old world. See their magnificent buildings, State capitals, court houses, churches, school buildings, with private residences equaling in splendor and decorations any to be found in the world. Look at our labyrinthic system of railways, which are a marvel of engineering skill and thought, that have been built even to the remotest corners of our country, so that the products of the farmer may easily and cheaply reach the markets of the world. What a grand sight it is to behold the thousands of acres of grain and corn just before the harvest season; with what pride the farmer points out its beauties to the observing traveler. One is lost in wonder and admiration at this vast area which has been brought to such a high state of cultivation by the industry of our farmers.

The pioneer farmers, who pushed their way to the west, and made the beginning for this great and rapid growth of our country that followed in their track, are deserving of great credit for their unfaltering perseverance. Their sufferings were necessarily of that character that none but the boldest and strongest could have survived, and their deeds of heroism must have been countless. Soon the wilderness was subdued, and a town was laid out; the school-house erected, and social life enlivened by their tales of wonderful preservation. What a glorious record to hand down to those who are now living upon the fruits of the pioneer farmer, who spent the best part of his life in subduing the soil, with a hope that his children might make a still brighter record. And how well they are fulfilling the fond wish, history proclaims in astounding figures from the department of agriculture.

There are many improvements which suggest themselves to a manufacturer or mechanic, as he rides through a farming community. One thing particularly noticeable is the absence of a suitable building for the storage of farm implements and small tools on too many of our New England farms. It is not an agreeable sight to one who has system and method in his business to see the mowing machine, the

tedder and the horse rake left where they were last used, or under a tree, to battle with the elements until wanted another season. These tools should be cared for as much as the carriage in which the farmer takes his family to church on the Sabbath. If they are in a proper building, where they can be looked after in the winter, the wood-work repainted, the iron-work kept well oiled or greased, to prevent rust, they will last twice as long as those left out in the field. And, further, if any misfortune should overtake the farmer, and his property have to be sold by an executor, his family would recover more than double the benefit. A manufacturer of mowing machines has said that a good mowing machine, well cared for, ought to last a farmer his lifetime, if he died in any kind of season.

Another improvement which suggests itself is to have more attractions about the home grounds. Little labor is required to prepare the ground for a few flowers, shrubs and foliage plants, and the delight the mother and daughters will take in beautifying is worth all the time expended in preparation of artistic beds to be bordered with foliage plants; a terrace for dahlias and asters; a mound for verbenas, not forgetting a place for the favorites of our mothers, — the marigold, poppy and sun flower; a rustic summer-house, covered with climbing vines, where the farmer can sit in the twilight and reflect upon the unrivaled picture before him, and see a beginning in solving the problem, how to keep the boys on the farm.

To be a successful manufacturer, a man must be educated to his business. He must thoroughly understand every detail, and, when his business is so large as to require it, he must have trusted foremen in every department, to look after the interest of the employer, and see that there is nothing wasted. Such a man seldom fails in what he undertakes. He is constantly on the lookout for improved machines which are required in his special industry. To-day there are large savings to a manufacturer, which but a few years ago were a waste. Scraps of leather about a boot and shoe factory, called gimpins, were formerly used as fuel in the stoves of the shop. Now a large and prosperous industry is carried on, in extracting the grease and oil from the

smaller pieces of this scrap, while the larger pieces are used for manufacturing heels for ladies' shoes. The dust and shavings from the trimming machines are carried directly to the boiler room by means of a flue. The shavings from the box shop are also blown to the boiler room. In a factory employing 1,500 hands, the saving in fuel from these sources is estimated to equal a ton of coal per day.

There is an enormous amount of capital invested in the manufacture of farm machinery, — larger than for any other industry, — as the selling season is limited to about two months. The first plough that history mentions is the Egyptian plough, — a crooked stick. The first recorded great improvement of this implement was made one hundred years ago by a Connecticut boy, then living in the wilds of central New York. He had become tired of the old wooden mold-board plough, and took it to the blacksmith and had the mold board covered with sheet iron. He found he could do much more work, and do it better. Farmers flocked to see it. Here was the beginning of improvement that has culminated in the iron and the steel plough of to-day.

I do not think the farmer realizes the large amount of money that has been expended, and is yearly expended, in introducing agricultural implements. The very best talent has to be procured to approach the farmer and set before him in glowing terms the benefits to be derived by adopting that particular implement. The eloquence is irresistible, and before the farmer is aware of it he has ordered one of those labor-saving machines. This salesman possesses a talent that there is a demand for, and commands a salary equal to our most favored clergymen.

Arkwright, the inventor of the cotton-spinning machine, was the youngest of thirteen children, the son of a barber, and he followed that business until he was twenty-eight. The first suggestion of the idea was by seeing a red-hot iron bar elongated by being made to pass between rollers. He experimented with the rods until he found he could draw out the fiber to the required degree of fineness. Popular animosity was excited against the man who was said to have abridged labor, but in reality had increased its sphere. His first factory was destroyed by a mob, in the presence of a

powerful military and police force, without a word of interference from the magistrates. He lived to overcome the prejudice, and to see his invention adopted. He died at the age of sixty, worth a half-million sterling. At one time he was so poor he had to be furnished with a suit of clothes before he could appear to vote at an election as a burgess.

Elias Howe, the inventor of the sewing machine, infinitely multiplied the results of labor; yet the suffering and privations he endured in his early struggles were very great. He was born in Spencer, and died in Brooklyn, N. Y., leaving a property valued at a million and a quarter of dollars.

There are a large number of illustrious names connected with our country's industries. You are all familiar with the history of those who have helped to swell the immensity of our almost innumerable institutions: Whitney, of cotton-gin fame; Hoe, of the rotary printing press; Fulton, who created modern commerce with his steamboat; Corliss, who revolutionized the use of steam; Franklin, who was called the electric or lightning tamer; but it was left for Edison, Bell and others to make electricity the servant of the people.

Asia, with her millions of inhabitants, continues to till the soil and work the shuttle and loom as her fathers have done for ages. Modern Europe has felt the influence and received the benefits of the incalculable multiplication of force by inventors' genius since the wars of Napoleon. And yet, only two hundred and seventy-one years after the little band of Pilgrims landed on Plymouth Rock, our people, numbering about one-fifteenth of the inhabitants of the globe, do one-third of its mining, one-fourth of its manufacturing, one-fifth of its agriculture, and own one-sixth of its wealth. The farmer, the manufacturer and the mechanic can rejoice that they have been co-workers in this great achievement, and believe that their united action has been the means of making this the most favored nation upon the globe. Let the good work go on. With loving hearts and willing hands, we may yet see New England reclaimed, and bearing with honor and dignity the euphonious title of "The Garden of the East."

We often hear predictions of what we may expect in the

way of future improvements, and we are constantly seeing these predictions verified. What will the next century bring forth in the line of improvements for the benefit of the farmer and manufacturer? I predict that in the large prairie farms of the West the motive power will be electricity; that the wind will generate the electricity; that a gang of ploughs will be made to work automatically, and the fields can be ploughed while the farmer sleeps; that scientific experiments will teach him the habits and weaknesses of the enemies of his crops, and they will have to relegate to the antipodes; the shepherd will hypnotize his flock, and have them at his merciful control; the breeder of domestic cattle will make his cattle domestic; rapid transit will be revolutionized, passengers and mails will be carried by aerial winds, and freight from the great producing centres of the West will be forwarded by pneumatic dispatch to the seaboard, at less than it now costs to haul it between Boston and Springfield. With these gigantic strides within a century, the old saying will need to be transposed to read, "Man wants but little here below, but wants that little quick."

# THE MASSACHUSETTS BOARD OF AGRICULTURE AND THE AGRICULTURAL SOCIETIES: CAN THEY BROADEN AND IMPROVE THEIR WORK?

BY WM. H. BOWKER OF BOSTON.

The Board of Agriculture and the agricultural societies of this State are so closely united that a discussion of one subject involves a discussion of the other. I shall not attempt to give the history of this Board or that of the societies, or review the work they have accomplished. That they have performed a great work no one can deny; that they are now doing some good work, all must admit; but that the work can be broadened and improved I believe is possible, and it should be undertaken at the earliest moment.

At the time this Board was established, forty years ago, it was the only organization supported by the State for the promotion of agriculture. Since then great progress has been made in agricultural education and experiment work. Agricultural colleges and experiment stations have been established all over the country, the outgrowth, we may almost say, of the early efforts of this Board. These colleges and stations are now doing much of the work which the Board and the societies were then expected to do. Although the work is now abridged in some directions, I shall try to show that it has been enlarged in other directions, and is still important.

### The Organization of the Board.

The law establishing the Board, while giving it oversight of the societies, does not give it much latitude in their management. It provides for the receiving of bequests made to the Board for promoting agricultural education or the general interests of husbandry. The Board also may

regulate the forms of the returns required from the different societies. Section 10 provides that the secretary of the Board can also appoint one or more suitable agents to visit the towns in this State, under the direction of the Board, for the purpose of inquiring into the methods and wants of practical husbandry, ascertaining the adaptation of agricultural products to soil, climate and market, encouraging the establishment of farmers' clubs, agricultural libraries and reading-rooms, and the dissemination of useful information in agriculture by means of lectures and otherwise. Such agents shall annually in October make detailed reports to the secretary of the Board. It is upon this section 10 that I shall base the suggestions of my paper, — a section which it seems to me has been allowed to lapse.

Including the members *ex officio*, there are now forty-three members on this Board, with two to be admitted, making a total of forty-five. Of these, thirty-eight will be appointed by the agricultural societies. Let us consider for a moment how these thirty-eight members represent the farmers of the State; and for this purpose I present Table No. 1.

## BOARD OF AGRICULTURE, — HOW CONSTITUTED.

TABLE 1. — *Showing the Present Representation on the Board from Each County, allowing One Delegate to Each Society, and comparing it with a Representation based on the Number of Farmers in Each County.**

| COUNTIES. | Number of Societies. | Number of Farmers. | Present Number of Delegates. | Number of Delegates to which Each County would be entitled, based on 1 to each 1,000 Farmers. |
|---|---|---|---|---|
| Barnstable, | 1 | 912 | 1 | 1 |
| Berkshire, | 3 | 3,325 | 3 | 3 1/3 |
| Bristol, | 2 | 2,788 | 1 | 3 |
| Dukes, | 1 | 292 | 1 | 1/3 |
| Essex, | 2 | 2,959 | 2 | 3 |
| Franklin, | 2 | 3,270 | 2 | 3 |
| Hampden, | 3 | 2,954 | 3 | 3 |
| Hampshire, | 4 | 3,112 | 4 | 3 |
| Middlesex, | 3 | 4,773 | 3 | 5 |
| Nantucket, | 1 | 109 | 1 | 1/10 |
| Norfolk, | 1 | 1,911 | 0 | 2 |
| Plymouth, | 3 | 2,134 | 3 | 2 |
| Suffolk (State), | 3 | – | 3 | – |
| Worcester, | 9 | 7,486 | 9 | 7 1/2 |
| Totals, | 38 | 36,025 | 36 | 36 |

* NOTE. — In round numbers, there are 36,000 farmers in the State, or an average of 1,000 to each of the 36 societies now represented on the Board.

## Analysis of Table No. 1.

Let us analyze this table. As Suffolk County has no farmers to speak of who gain their living solely by farming, it is supposed to have no representation on the Board, although it should be borne in mind that it pays one-third of the State taxes. We will, however, let the delegates from the old Massachusetts, the Massachusetts Horticultural, and the Bay State societies, three in all, stand for Suffolk County. This leaves thirty-five to represent the other counties of the State. Based on the number of farmers, Dukes and Nantucket counties would not be entitled to a single delegate, whereas they now have two. Worcester County now has nine delegates, and is entitled to a little over seven. Bristol County has one where it should have three, and Norfolk County, with almost 2,000 farmers, has no representative on the Board. The only county fairly represented is Berkshire, which, with 3,000 farmers, has three delegates. I submit whether the Board as now constituted is a fairly representative body of the farmers of the State, based upon their numbers.

## Distribution of State Bounty.

Let us now consider for a moment how the money given by the State is distributed among the counties through the agricultural societies; and for this purpose I present Table No. 2.

## STATE BOUNTY TO AGRICULTURAL SOCIETIES, — HOW DISTRIBUTED.

TABLE 2. — *Showing Amount Each County would receive if divided according to Number of Farmers, and the Amount actually received in 1890, on the Present Plan of $600 to Each Society.*

| COUNTIES. | Number Societies in Each County. | Number of Farmers in Each County. | Amounts which Each County would be entitled to, based on Number Farmers. | Amounts Each County received 1890, based on Number Societies. | More than Average Proportion, based on Number Farmers. | Less than Average Proportion. |
|---|---|---|---|---|---|---|
| | | | | | Per Cent. | Per Cent. |
| Hampden, | 3 | 2,954 | $1,610 00 | $1,800 00 | $190 00 or 12 | – |
| Worcester, | 9 | 7,486 | 4,080 00 | 4,800 00 | 720 00 or 18 | – |
| Barnstable, | 1 | 912 | 497 00 | 600 00 | 103 00 or 21 | – |
| Hampshire, | 4 | 3,112 | 1,696 00 | 2,400 00 | 704 00 or 41 | – |
| Plymouth, | 3 | 2,134 | 1,163 00 | 1,800 00 | 637 00 or 54 | – |
| Dukes, | 1 | 292 | 159 00 | 600 00 | 441 00 or 275 | – |
| Nantucket, | 1 | 109 | 59 00 | 595 00 | 536 00 or 890 | – |
| Berkshire, | 3 | 3,325 | 1,812 00 | 1,800 00 | – | $12 00 or 06 |
| Franklin, | 2 | 3,270 | 1,782 00 | 1,200 00 | – | 582 00 or 33 |
| Essex, | 2 | 2,959 | 1,613 00 | 1,028 00 | – | 585 00 or 36 |
| Middlesex, | 3 | 4,773 | 2,602 00 | 1,200 00 | – | 1,402 00 or 54 |
| Bristol, | 2 | 2,788 | 1,509 00 | 600 00 | – | 909 00 or 60 |
| Norfolk, | 1 | 1,911 | 1,041 00 | – | – | 1,041 00 or 100 |
| State Societies, | 3 | – | – | 1,200 00 | – | – |
| Totals, | 38 | 36,025 | $19,623 00 | $19,623 00 | – | – |

### Analysis of Table No. 2.

What does an analysis of this table show? Suffolk County is left out, although she contributes over $6,000 of the $19,623 given in State bounties. Four societies of the different counties did not draw their share, either because they did not care to do so, or because they were not in a position to comply with the requirements; but two of these will comply next year. Two more drew only a portion of the $600, because they complied only partially with the requirements. Next year these two will probably be wiser, and will be in a position to draw all of it.

With these exceptions, however, we find that Berkshire County, based on the number of farmers, is drawing nearly its share, while Worcester County is drawing 18 per cent more than its share, and next year will draw about 30 per cent in excess. Dukes and Nantucket counties, with a population consisting mostly of fishermen, are receiving 275 and 890 per cent, respectively, while Norfolk County is not receiving a dollar. Is not this a peculiar state of affairs? It will pay to study this table carefully, and note the inequality of distribution.

But, before leaving this matter of State bounty, I want to present it in another light: —

| | |
|---|---|
| Number of farmers in Massachusetts, . . . . . . . | 36,000 |
| Amount appropriated in 1890 by the State for State bounty and expenses of the Board of Agriculture, including the printing of reports, in round numbers, . . . . . . . | $36,000 |

This, as you will see, is equivalent to one dollar to each farmer, or $1,000 to each of the thirty-six societies now represented on the Board.

### The Present Plan.

Under the present plan of disbursement, expressed in dollars and cents, the fisherman farmer of Dukes County is receiving $4.00 worth of benefit, while the Essex County hay farmer is getting only 66 cents' worth. The stock-raiser in Worcester County is receiving $1.25 in benefit, while his market-garden neighbor in Middlesex County is obliged to take up with 60 cents' worth. The vegetable

grower of Plymouth County gets $1.40, while across the line in Bristol County he receives only 37 1-2 cents. The Hampshire County tobacco grower receives $1.33 worth of good, while the butter maker in Franklin County must content himself with only 62 1-2 cents. The whale farmers of Nantucket, 109 all told, are supposed to swallow up $9.00 worth each, while the milk farmers of Norfolk County, 2,000 strong, are not receiving a single cent.

Need I carry the comparison further? As one indignant Norfolk County farmer expresses it, "We are getting only a few dry husks, bound up in a black volume, called the Agriculture of Massachusetts."

### The System at Fault.

It must not be inferred that any blame rests with the island counties, for it is not their fault that they are receiving more than their proportion. Neither can the secretary be criticised, for he is doing good work with the material which he has at his command. Nor does the fault lie with this Board, but rather with the system, which may have been right forty years ago, but which to-day we have outgrown. It also may be said, in defence of the island counties, that, as they possess a poor soil, they deserve more encouragement; but I doubt whether you can encourage agriculture where the natural industry is fishing, and keeping summer boarders.

As to Norfolk County, it had at one time the most vigorous society in the State. This Board grew out of the effort of the old Norfolk society, through its great leader, Marshall P. Wilder. All honor to that society, and the man who founded it. It died, however, with its founder, but the county is not dead. It might establish a number of societies, obliging the State to further swell its lists of bounties; but I am inclined to think the county deserves great credit for its consideration of the State in this respect.

### Too Many Societies in the State.

Are there not more societies now in the State than can live? Is it not necessary for many of them to resort to horse-trots, side-shows, rents from fakirs, balloon ascensions,

public marriages in the air, and all sorts of circus attractions to keep their heads above water? "It is amusement for the people, and is legitimate," says one writer. But is it amusement for the people that the State is seeking? It may be good policy for the State to promote local holidays and to contribute money to the entertainment of the people; but, if it is, let it be done under its right name, and not under the guise of "for the promotion of agriculture." Let the funds contributed by the State for this purpose be called "amusement funds," rather than "agricultural funds." I do not charge nor should it be inferred that the State bounty is *directly* used for the amusement of the people, for each society is required to pay out in premiums for agricultural purposes as much as it receives in bounty from the State; but there are societies which could not exist without the bounty, and yet while receiving it are paying more attention to the amusement features than the agricultural features, and thus the State is made *indirectly* to aid in the support of a class of societies where the promotion of agriculture is secondary to the amusement of the people.

### The Twelve-mile Limit.

At the present rate of formation of agricultural societies, ostensibly for the purpose of promoting agriculture, but practically for a local holiday, by 1900 we shall have societies within the twelve-mile limit established under the present law, all over the State, each drawing its bounty of $600. On the twelve-mile-limit plan, according to mathematical calculation, there is room in the State for fifteen or twenty more societies; and on the hexagonal plan, planting them as we would so many trees in an apple-orchard, we might squeeze in one hundred more. If the twelve-mile-limit plan is feasible, it is just as feasible to begin now and plant the remaining one hundred, without reference to inhabitants or local conditions. So far as Worcester County is concerned, a portion of which I happen to represent, she will no doubt put in her work before 1900, and have the entire county dotted with flourishing cattle shows, so called, where the jockeys and fakirs will reign supreme, while the cow will be crowded into one corner of the grounds, as

now, and the farmers will look on, many with indifference and more with disgust.

I repeat, is it wise, under the existing circumstances, to encourage the establishment of any more societies in the State at the expense of the public treasury, when the same money might be more judiciously used in other directions?

### The Farming Population as a Basis.

I have referred to the disproportion of representation on this Board, and to the unequal division of State bounty when taken by counties. It may be urged, however, that it is not right to base representation and division of bounty on the number of farmers, as the whole State is benefited. This is, no doubt, true. Yet it seems to me that there may be some fairer division than is now in vogue. If we took the whole population as a basis, or the property valuation of different counties, the larger part would fall to Suffolk County. This would not be right, as the present law contemplates a direct benefit to the farmers in each section, and indirectly to the whole State. Therefore, it seems to me that the only just basis of representation and division is by the number of farmers in each county.

### The Present Board too Large.

It is clear that, if some change is not made soon, this Board will shortly resemble a town meeting in size, and be as unwieldy. The Board of Agriculture of Michigan consists of eight members; Illinois, twenty; New Hampshire, ten; Connecticut, thirteen; while the great State of Ohio, with 260,000 farmers and 247,000 farms, is doing good work with a Board numbering only ten members, elected by delegates from all the county societies meeting in convention at Columbus. Our Board is four times as large, while there are less than one-seventh as many farmers. No State in the Union has so large a board as Massachusetts. Before we can hope to broaden and improve the work of this Board and the agricultural societies, I believe we shall find it necessary not only to reduce the membership of the Board, but also to rearrange the agricultural system of the State to some extent. With this end in view, I suggest the following plan for your consideration.

## Plan of Reorganization.

*First.* — Let the State be divided into nine districts, based upon its agricultural population, each district to have a representative on this Board, to hold his office for three years; except the first term, when three would fall out the first year and three more the second year, and after that the election would proceed in regular order; or we might take the Congressional districts, allowing one delegate from each district, as is the case in Illinois.

*Second.* — Let each agricultural society nominate a candidate for representative to the Board. In some districts there would be several candidates, or as many as there were societies, which would promote rivalry and interest.

*Third.* — Invite the farmers of each district to vote on the candidates nominated by the different societies, voting by postal card, the one receiving the highest number of votes to represent the district on the Board for three years. This plan would call for an election in three of the districts each year, all the districts voting the first year, and after that the order of voting to be determined by lot, or any other fair way.

*Fourth.* — Have, if you please, three members as now, at large, appointed by the Governor, who can stand for the State or for Suffolk County.

*Fifth.* — Add to the Board, either by election of the Board itself, or appointment by the Governor, five specialists; namely, a chemist, a botanist and geologist, an entomologist and ornithologist, a veterinarian, and an engineer. These should be *ex officio* members of the Board, besides the Governor and president of the Agricultural College, as at present, and also the secretary, who should be elected by the Board. The Board would then be made up of sixteen or seventeen members, instead of forty-five, as at present. If this seems too small or too large, the districts in the State could be increased or reduced; but I would not reduce the number of specialists, if we would have the work of the Board of a high order.

*Sixth.* — Abolish the cattle commission as it now stands, and elect three members of this Board, who shall be known

as the cattle commission committee, with the veterinarian as a member of the same. This is the Connecticut plan, and I understand that it works satisfactorily, being fully as efficient, and more economical.

*Seventh.* — Dispense with the present Board of Control of the Massachusetts Experiment Station, and elect from this Board a committee known as the experiment committee, of which the president of the Agricultural College shall be chairman, and the chemist to the Board the director, as is the case at present.

This outline of a plan may seem to many radical and unwise; but I submit it as a basis, hoping that out of it may grow a scheme that shall be acceptable to this Board as well as to the State at large. The plan as I have outlined it is not entirely original with me, for there are precedents in other States for many features of it.

### The Plan in Detail. — Voting by Postal Cards.

Let us discuss the plan for a moment in detail. The districts can be easily arranged, when we have determined the number of delegates we shall have; and I think no one will object to taking the number of farmers as the basis of representation.

As to voting by postal card, there are many advantages in that, as we shall see. According to the returns, there are about 30,000 members of the different societies, counting men, women and everybody, including the fakirs. What proportion are actually farmers no one knows, but it is safe to say that not over one-third, or 10,000 out of the 36,000 farmers in the State, are members of agricultural societies. Every one knows that the annual meetings of the societies are very poorly attended. Probably not over ten per cent of the farmers of the State actually vote for delegates to this Board. As the societies are now conducted, I dare say the vote is exercised very largely by men who are not farmers.

A man entitled to a vote by postal card, under this plan, should be one who gets his living by farming, or one who owns a farm which is tilled under his direction; and the town clerk in each town should be required to certify to a

correct list of such men each year, and file it with the secretary of this Board, who should issue the postal cards, and to whom they should be returnable.

As to the expense of voting by postal card, that can probably be arranged at a cost of not over $300 a year. If the State can furnish ballot-boxes and ballots for each precinct every year, I do not think it would object to expending a reasonable sum for a proper ballot for representatives to this Board.

### Must Reach the Practical Farmer.

We must reach out and take hold of the practical farmer in some way, and make him feel that he is a part of the agricultural machinery of the State, and has a voice in its management, if we would encourage and stimulate him in his work. It may be said that, if he has not sufficient interest to join an agricultural society and attend its meetings, he is of so little account that the State should not specially recognize him. But section 10 of the law establishing this Board implies that it is created for educational purposes; and, that being the case, we should strive to help the very class for whom it was created, — the husbandman, — *whether he desires it or not.*

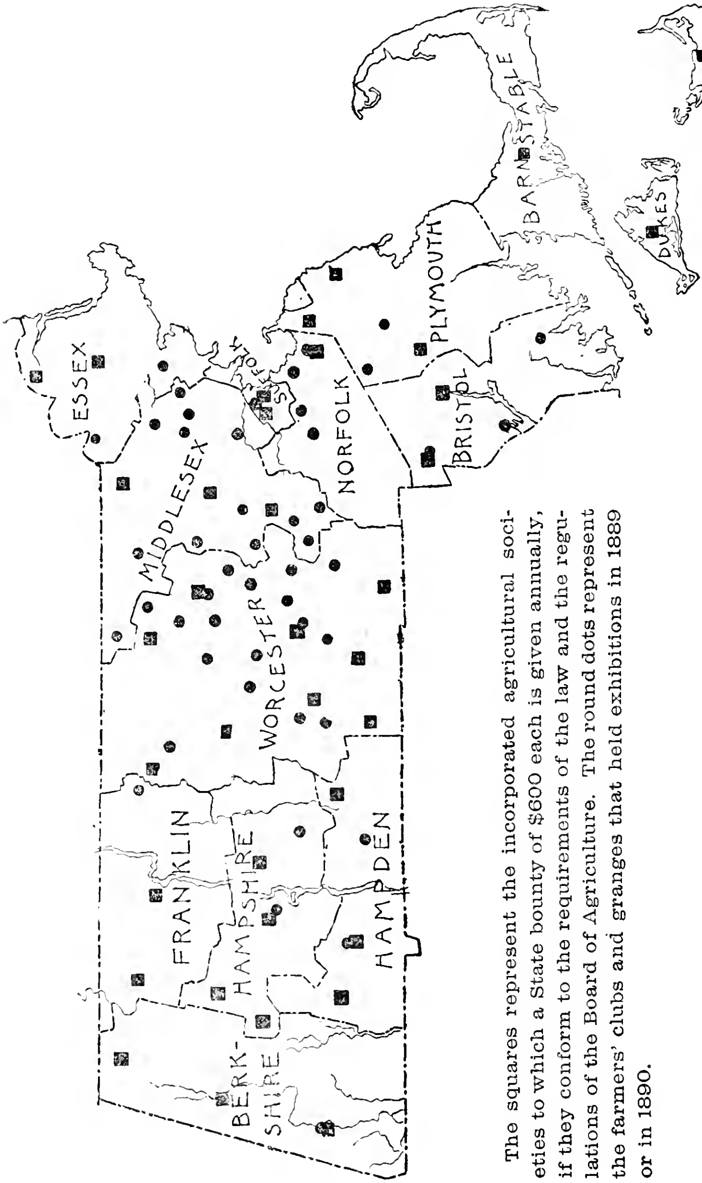
I believe this method of voting by postal card is perfectly feasible, and would elicit the interest of all the farmers of the State, and a Board elected in this way would truly represent all their interests.

Then, what an advantage such a list of certified farmers would be to the secretary. He would be in constant touch with all the farmers of the State; and if at any time it seemed necessary to issue a special bulletin, he could reach them all in twenty-four hours. As to the other features suggested, they no doubt will appeal to your good sense, because they are in the line of economy, and will not lessen the efficiency of the Board.

### How shall we broaden and improve the Work of the Societies?

The holding of cattle shows is not the whole work of an agricultural society, although many people think so, and the State law even is based on that idea, for it does not allow the

payment of bounty unless a fair was held the previous year. This, it seems to me, is wrong. The original cattle shows were exhibits of cattle and stock, to familiarize the people with higher types, and to encourage better breeding. From




The squares represent the incorporated agricultural societies to which a State bounty of $600 each is given annually, if they conform to the requirements of the law and the regulations of the Board of Agriculture. The round dots represent the farmers' clubs and granges that held exhibitions in 1889 or in 1890.

that they grew into a general exhibition of all sorts of farm products; and it has now become a "Fair," with the cattle and the farm products in the background, and attractions to amuse the people in the foreground. Last fall there were thirty-five agricultural fairs held by the incorporated societies drawing bounty from the State, besides fifty exhibitions by town granges and farmers' clubs, or a total of eighty-five shows in the State, nearly all held within six weeks.

### The Cattle-show Business Overdone.

The agricultural show business in Massachusetts is evidently overdone; but I would not discourage the holding of local town shows, for these, it seems to me, are fully as valuable as the larger ones. Neither would I prevent the established societies from holding exhibitions if they desired them for a public holiday, but I would not make it a stipulation that each society must hold a fair in order to draw the State bounty.

There are certain localities that are favorable for holding great shows each year, even without bounty from the State. Brockton is one of them. While giving a very creditable exhibition of stock and hall displays, it excels in furnishing attractions for amusing the people. I confess that I like to go to the Brockton show, for the same reason that I like to go to Barnum's circus. It amuses and entertains me. As an agricultural circus, it is a great success. If there are societies favorably located for this kind of business, — for it is a business requiring special talent, — I am not sure but that it is perfectly legitimate; but the State should contribute no bounty directly or indirectly to such societies.

### The Bounty Controlled by this Board.

As to the bounties, I believe the amount in the aggregate which is now given to the different agricultural societies should be continued, but that the expenditure of it should be under the direct control of this Board. This will be bitterly opposed; but you will admit that some change should be made, for much of the money given to the societies at the present time is worse than squandered. In some

sections the present system is developing a class of professional exhibitors, both of cattle and horses, who travel about from one society to another, and from State to State, with well-groomed herds, taking premiums that should go to farmers in that particular locality. *It is the amateur pitted against the professional.* To such an extent has this practice grown, that in some societies hardly anything but "professional herds" appear, the local farmer staying at home, or leaving his stock there. It is true that these "professional herds" are usually excellent types, and afford good object lessons, and it may be well to have them present. In that case let us hire them to exhibit, instead of paying them the premiums which rightfully belong to local exhibitors.

### A New Departure in the Use of State Bounty.

I would not take the $600 bounty from a weak society struggling into existence, and paying premiums judiciously to farmers within its own limits, but let it proceed as heretofore.

In a society, however, like Worcester, the $600 might be used for carrying on some practical work in the way of field demonstration, such, for example, as in the use of insecticides. How many farmers of this society, for instance, know how to prepare the Bordeaux mixture or other insecticides, and apply them in the most effective way to fruit and foliage trees? Moreover, what difference would it make to the Worcester society in its success, whether it received the $600 or not? Its total expenses and receipts are upward of $30,000 yearly, and the question of its success cannot in any way depend upon the State bounty. Therefore, in this society the money might be well expended for a number of years in field work of this kind.

### Dairy Schools.

In another society, Barre, for example, which is now out of debt, the $600 could be used in giving practical illustrations in the manufacture of butter and cheese. There are as many as a dozen different varieties of cheese sold extensively in this country, most of which are imported. Is

there any good reason why we should not make them here? And is there any good reason why this Board should not send abroad for men or women who understand how to make these varieties, to teach the process in the dairy sections of the State? The $600 could well be expended in the Barre society and in Franklin and Berkshire, in work of this kind.

## Cooking Schools.

Again, take the Worcester Northwest Society, which I represent. Here, practical demonstrations could be given in farm cookery; and, as the society is made up of mechanics and farmers, it would be a benefit to both classes. What a splendid thing it would be to establish for a while in the town of Athol, the centre of the district, a cooking-school that should inculcate better methods in the culinary art. If any one here wants to know how that art has degenerated, let him stop at some of the country hotels whose cooks are recruited from the neighborhood. The same sort of work could be carried on for a time in the Fitchburg and Taunton societies, and so on from county to county. In such work we should be directly benefiting and interesting the women of the farms; and who need to be encouraged more?

## "Balanced Rations" for Table and Stable.

What we need throughout New England is a class of men like Professor Atwater of Washington, and Mr. Edward Atkinson of Boston, who shall go about teaching the chemistry of table foods, and the relations of different food substances to each other. Our agricultural papers are full of "balanced rations" for the cow, the pig and the horse. We know almost to a nicety how to feed for milk, for butter, or for muscle and fat. We are studying the relations of protein to carbo-hydrates, in our rations for the stable; but are we studying them with reference to the food which we place upon our tables? We are thinking more about the diet of the calf than of the child, more about the food of the cow than of the mother and daughter. Heaven grant that we may not become so sordid that we shall see only the dumb animals on our farms, and forget the human beings.

### ROAD MAKING. — SOILS, GRASSES, ETC.

In the Middlesex North, at Lowell, the $600 could be expended for a time in illustrating better methods of road making; while in the Middlesex South, at Framingham, the money might be used for lessons in forestry, and, if you choose, in supplying seeds for forest preservation.

In the Hampden Society the bounty could be expended in experiments with tobacco, while on the Cape it could be used in work relating to the cranberry.

How many farmers know the character of the rocks and soils, also the grasses, and their habits of growth? Suppose a school should be called in Concord, to study not philosophy, but nature, as exhibited in the rocks and grasses of our fields. Let the instructor be a practical botanist and geologist, who shall know how to present the subject with a great deal of sense, and sufficient science to make it accurate.

In some sections the money could still be used for granting premiums upon stock, the Board itself to determine to what class of stock, and how, the premiums should be awarded.

### SANITATION OF MILK FARMS. — TRAVELING SCHOOLS.

In the milk sections, which supply milk for the Boston market, the bounty could be used in demonstrating the importance of better sanitation in farm barns and buildings, by lectures given on the ground, pointing out diseased cattle, with clinical demonstrations. Let tuberculous cattle be examined, and the difference shown between those diseased and healthy. At another time let the water and drainage of the farm buildings where milk stock is kept be discussed, observing the good features and criticising the bad ones, — in short, giving object-lessons which shall appeal to the eye and the sense of the practical farmer. Upon this subject Governor Hoard of Wisconsin has spoken to the point. He says: "Somebody must be educated; but the business of milk raising is in the hands of farmers and their sons, who cannot all be sent to a special school. Farmers have accustomed themselves from childhood to judge by the eye alone. Perhaps I am a little skeptical on this subject, but I believe

more in going about the country and getting in with the people of a neighborhood than by any other means. I believe dairy education of most value is to be found in these traveling schools, and their centers should be at the factories and creameries now in existence. These are practical schools, and appeal to the sense and understanding of the farmers."* We should have traveling schools that shall give oral and optical demonstrations in the various departments of husbandry. We may not know just how it will work, but let us begin, and after we have begun we shall find that knowledge and experience will light the way to further progress.

This Board, in conjunction with the societies, should also take up the work of developing the consumption of certain food products, such as milk, cheese, mutton, fruits and vegetables.

### State Control of Milk Supply.

Why should we not take steps, not only to improve the milk supply of large cities, but also to increase its consumption, — for it is a healthful article of food *if it comes from wholesome sources.*

I go so far as to believe that it is for the welfare of the State to take an active interest in the milk question. City governments believe that it is for their interest to control the water supply; but the article of milk, more difficult and delicate than water to handle, drawn from sources that are

* President Goodell, commending this feature of the plan, says: "In Germany, itinerant lecturers are employed by agricultural societies, who travel about giving such local information as would be of practical benefit to the farmers. In France, ninety departmental professors of agriculture are supported by the government at an expense of $57,000 annually, whose duty it is to deliver lectures on agriculture to teachers and to farmers in the towns of the district. In Belgium the fifty-two agricultural societies engage itinerant lecturers to give information on selected subjects to farmers in the chief villages. This plan is also followed in the Netherlands. In all these countries, the effort is made to bring the information direct to the farmer. Jenkins, in his report for 1884, says: 'In Denmark the butter sold in the markets was execrably bad. To-day it has no rival in the London market. The result is directly attributable to the technical instruction given by the lecturers employed to go about from place to place.' The same tale is told both of the amount and quality of other articles exported, especially of barley, pigs and cattle. In Ireland a traveling educational dairy owned by the Royal Agricultural Society of Ireland is employed, in which churning is done three times a day while the lecturer gives instruction. Prizes are offered to the dairymaid passing the best examination after having attended three consecutive lectures. The improvement in the quality of butter in the districts where this dairy has been wheeled about has been most marked."

more likely to be polluted, is left in the hands of thousands of men, many of whom are ignorant and unscrupulous.

Dr. Peters of Boston says that at least ten per cent of the cows about the city are affected with tuberculosis. If this be the case, it will take a great many Dr. Kochs and a great quantity of lymph to counteract the evil which will arise therefrom.

The German government is controlling the manufacture of the lymph for the cure of consumption. Perhaps it might be well for Massachusetts to control the milk supply, which is said to be one of the greatest sources of the seeds of consumption. This Board can certainly do something if it will set itself earnestly to work upon the subject.

### Age of Milk. — Sterilization.

In this connection is the question of the age of milk, and its sterilization. There appeared in the "Boston Herald," a few weeks ago, a very able article by Dr. Henry J. Barnes upon the age of milk, contending that most of it was too old. He writes: "Half this milk is thirty-six and half forty-eight hours old before it reaches the consumer . . . . I know of no city of Europe or America where such a complicated system of handling is practiced. . . . From an economic point of view, the system is bad; from its influence on public health, it is criminal."

Other physicians, knowing how difficult it is to get milk free from disease germs, have urged its sterilization; and one wealthy lady, Mrs. Frances Fisher Wood, has started this industry on her Vermont farm, and is shipping the product to New York City. The proper sterilization of milk not only destroys all disease germs, but will preserve it for some length of time. If we are not mindful, this industry may be the means of bringing milk from remote points to compete with the fresh milk of Massachusetts, and we shall find ourselves in the same condition as when "oleo" was introduced, and creamery butter brought from Iowa.

Since there are in round numbers 200,000 cows in Massachusetts, is not the whole milk and dairy question an important one for this Board to consider specifically? Nay, is it not a philanthropic one, as well? If it is not desirable for

the State to assume responsibility, would it not be well for the Board to take some steps to bring both city consumer and country producer together in some efficient organization that shall better protect the public health as well as the farming interest?

### Abandoned Farms.

As has been stated, there are 36,000 farmers in Massachusetts, and in round numbers say 45,000 farms, or apparently 9,000 in excess. Should we not ascertain how many of these farms are actually abandoned, and try to build them up again? The New Hampshire Board of Agriculture has taken up this question, and the Boston press is constantly speaking of the abandoned farms of New Hampshire. As a result of this discussion, coupled with the efforts of the Board, nearly 400 have been sold in New Hampshire within the last year, many of them for country homes of city people who read about them in the Boston papers. Why not set the Massachusetts press to talking about the farms of Massachusetts, many of which are just as beautiful, and richer, than those in New Hampshire, and so keep the money within our own State? I am told that it is contemplated to introduce a bill into the Legislature, establishing a commission to investigate this subject. If this matter is placed in other hands than this Board, what a sad reflection it will be upon it.

### No Call for Original Work. — Dispense with Annual Report.

There is no call for this Board or the societies to do original work, as heretofore. The agricultural experiment stations and colleges are occupying that field, and it seems to me that it is now a part of our business to popularize the results which are obtained by these institutions, standing, if you please, between the scientist and the practical farmer, — to sift the wheat from the chaff and sow the good seed throughout the State.

Instead of expending $7,000 or $8,000 a year in printing the annual report of the secretary, let the same money be used in sending to certified lists of farmers, abstracts in

popular form and simple language, of any important agricultural work in this or other countries. Massachusetts farmers are receiving to some extent the work of our own station, but there may be valuable bulletins issued by other stations, of which we ought to have the benefit. Then there are valuable papers read before the Board from time to time, which are literally buried in the reports. Abstracts of the papers read at our last public winter meeting at Worcester ought to have been sent to every farmer in the State within a week after they were delivered. Mr. Wood's valuable paper on fruits, delivered at Easthampton last year, now buried in the agricultural report, should have been spread broadcast throughout the State; while Mr. Goddard's paper on "Choosing an Occupation" ought to have been placed in the hands of every farmer's boy. The reports of the Board are widely circulated; but black volumes are bulky bugbears, while leaflets containing pithy statements are popular, and will be read from beginning to end. The agricultural press is doing a great work in this direction, and deserves recognition; but the work should not be left entirely to the press.

### Reform the Institutes, etc.

The institutes have also done good work, but they also need to be reformed. In many of the societies they are now perfunctory meetings, held simply for the purpose of complying with the requirements of the Board, in order to obtain the State bounty. The institute of to-day is losing its hold and influence, and its place must be taken by a system of instruction that shall more directly appeal, as Governor Hoard says, to the "good sense and understanding of the farmer."

I have tried to present a line of work broad enough to keep this Board and the agricultural societies employed for some time to come, — work which it seems to me is directly in harmony with the laws establishing the societies, and also with section 10, of the law which established this Board, which provides for suitable agents to go about the State not only to inquire into the methods and wants of practical husbandry, but also to disseminate useful information by means of lectures "and otherwise." These agents could be the

specialists and teachers to which I have referred, and the methods denoted as "otherwise" could be those of the traveling schools, and the practical lessons in the field.

### The Other Boards of the State.

I believe this Board should not only be reduced in numbers, but made in part a bureau, with an able and efficient corps of assistants. When this is brought about, it will be in a position to work in line with the other boards of the State. The Board of Education has ten members, the Board of Health eight, while ours has forty-five. Although their fields of labor open one into the other, these three boards can never meet upon a common ground and work together for the best interests of the State until our Board is brought to a basis more nearly corresponding to theirs, and the fact that no other State in the Union has so large a board of agriculture as ours, most of them numbering ten to fifteen members, adds force to this suggestion.

### Conclusion.

Our secretary is earnest and zealous, but he cannot do more than he is doing, or even different work, until our system is changed, and more funds placed at his disposal. I would not, however, ask for larger appropriations, for the State is almost prodigal in her gifts to agriculture. *No State gives more. I think no State gives so much.* It is our duty to see if we cannot use whatever is given to better advantage, and also, by a reorganization of this Board, greatly improve and broaden its work, as well as that of the societies which should come more directly under its control, so far as the use of the State bounty is concerned.

In closing, let us understand just what this plan contemplates.

*First.* — A reduction of this Board in numbers, and making it more representative and to more nearly correspond to the boards of other States and to those in our own State.

*Second.* — To consolidate several of the agricultural bodies of the State into one, under the control of this Board.

*Third.* — To regulate the use of the State bounty given to the different agricultural societies, but in no sense to regulate the management of these societies. They to continue the management of their own affairs, as they see fit, to use their own money as they choose, and also to draw the State bounty or not, as they like; but, if they draw it, this Board to determine whether it shall be applied for premiums, or used in giving instruction by means of traveling schools, institutes, and otherwise, each society to be fully heard as to its wishes in the matter.

The present system is the outgrowth of legislation, and it will require legislation to remedy it. Let us ask for that legislation ourselves, before it is pressed upon us by public sentiment, remembering that other States are leading us to-day, and we must not lag behind.

# ESSENTIALS TO SUCCESS IN FARMING.

BY P. M. HARWOOD OF BARRE.

Human happiness, and not wealth, as many suppose, is the great object of human effort. The question, then, of how to obtain happiness or success in life, becomes a most important one to the young, and a most interesting one to all. And in no degree is this less true of farmers than of those engaged in other occupations. If farming is the occupation chosen, then success in farming should be the ambition and form the purpose of the farmer's life, to the end that he may, in so far as his business is concerned, add not only to his own happiness, but as well to the comfort and happiness of all those about him, — his family, his neighbors, his friends, his townspeople, and the State. This purpose in life is an all-important essential to success. Without it, no one will succeed. With a well-defined purpose, and a determination to adhere to it through whatever difficulties, the battle of life is half won before a gun is fired. Even after this labor ceases to become drudgery, all effort becomes directed to the accomplishment of the ends in view; blows count, and life itself is clothed with renewed beauty. Most people have a purpose, even though it be the purpose of a day. But the great difference between marked successes and multitudinous failures lies in the difference in the magnitude and grandeur of the purpose primarily, and secondarily in the manner in which that purpose is carried out.

I apprehend that much of the comparative failure among farmers is due to the half-heartedness with which they engage in their work. Some are there because ill health has driven them from the cities to seek the invigorating air of the

country; others, because of father or mother who needed tender care through declining years, — most admirable devotion and most commendable self-denial, it is true; others still, because they were born there, and had not the moral courage to get away. Not one of the above classes is on the farm, you will observe, because he wanted to be, or because that was his chosen occupation, or because of his desire to excel in farming, or because that was his purpose in life. On the other hand, there is hardly a professional man and but comparatively few business men in this State who did not enter their professional or business calling from choice, and because they had a greater or less ambition to succeed.

This is only one of a vast number of burdens which agriculture has to bear. It must be a reasonably profitable calling, for certainly no other could stand such a variety of loads. Unjust taxation, government land distribution, railroad monopolies, insurance frauds, trusts, grain gamblers, milk contractors, etc., from without, to say nothing of the half-heartedness and the unbusinesslike principles too often adopted by the farmers themselves. What other business could stand it? Thank God there are some farmers in Massachusetts who are not guilty of these last-named errors. We have them in this Board of Agriculture. We know them in every county in this State. We only wish there were more of them.

In addition to the first great essential to success, — purpose, — there should be love of calling, knowledge of the business, perseverance, and the application of business principles. There are two habits which should be formed, indeed, they are imperative, — the habit of industry and the habit of economy. Add to these virtue and integrity, and we have a man fairly well equipped to become a successful farmer. There are other things greatly to be desired, such as good health, good judgment, good executive ability, power to say no, and, lastly, the family relation. These are the essentials, absolute and relative, which will be considered in this paper as essentials to success in farming; and we shall have in mind farming in Massachusetts.

### Purpose.

In addition to what has already been said concerning the desirability and value of purpose, let us consider, as subdivisions, foresight, plan and ends. The man with foresight has a great advantage over his fellowman who has it not. About everybody is blessed with hindsight. But the ideal man of hindsight is found in the little coterie of loafers hanging about the country grocery store of a Saturday night. Who of us has not seen him, and who has not heard the wisdom expounded by this wiseacre?

Foresight can be cultivated. The man of purpose sees this — sees the advantage to be derived, and soon becomes himself a man of foresight. He also becomes a man of plans. He plans wisely and hopefully for the future. He not only has his life plan, but he has a plan for each year, another for each month, another still for each day. Great indeed is the advantage of all this. Labor shaped to the accomplishment of an object, no hesitation, no lost time, blow follows blow, all blows count, wonders are accomplished, and all this while his neighbors are hunting, fishing, or talking about him or somebody else in the neighborhood. The ends accomplished by the man of purpose are not always what he intended them to be. Man proposes, but God disposes. This should discourage no one, however. Nine times out of ten success is attained, if not just in the way we planned, still, in some other and very likely on the whole equally satisfactory way. Life at all events has not been without its fruits; it has been worth the living.

### Love of Calling.

Love of calling involves adaptability to calling. Wherever there is a will there is a way. Adaptability follows love in natural sequence. But love for farming does not necessarily imply that one will love all the details of farm life, or that he will not be called upon to do much that is unpleasant and distasteful to him. And he who has not learned the valuable lesson disciplining him to cheerfully perform this sort of work, has missed one of the most important conditions of success. There is great advantage to be derived from love for one's calling; it is an important essential to success.

### Knowledge.

A thorough knowledge of the business of the farm is of the highest importance. Thorough knowledge involves a great deal. It not only includes the lessons of past experience, but also the lessons which each day brings with it. Every man should be posted in his particular line of farming up to date. In that way alone can he hope to keep in the front rank. He must read, he must think, he must act. Agricultural newspapers and experiment station bulletins bear to him the advanced thought of the day, and the latest results in the way of experiments. He must glean from these with rapidity and unerring accuracy the results which are of use to him in his business; and, if there is anything that comes to him which will aid him, it is not enough for him to say, "I ought to apply this to my business," but he must get right down to work, and apply it, — be the first man, if possible, to reap the benefit in a practical way. If these things are of use to anybody, they are of use to those who are first to apply them.

A thorough knowledge of the commonest details of farming are of vital importance. A man ought to be able to perform any and all kinds of farm labor in the best possible manner. He is then able not only to work to advantage himself, but also to show his men how to work to advantage. To-day a knowledge of mechanics is highly essential to successful farming. The use of farm machinery is on the increase every year, and it takes a mechanic to run a machine economically. From want of knowledge on this score a great amount of waste occurs upon our farms every year. Many repairs can be made by farmers themselves, thus saving many dollars which would otherwise go into other hands. Knowledge is indeed power.

### Perseverance.

The class of which I was a member in the Agricultural College had for its motto "knowledge, perseverance, success." If I were to write this essay in three words, I would use my old class motto. Perseverance is indeed an essential to success. It has fought the noble battles of life

in its every department. Victory belongs to him that overcometh. It was perseverance that carried the hero of Appomattox to victory. It is perseverance that carries ten per cent of those who are successful in business life in triumph over the ninety per cent who go down. It is perseverance that has rewarded every farmer in this Commonwealth with such measure of success as he has attained. Many and many a man has failed on the very threshold of success for the lack of it. If there is any one word that I would leave ringing in the ears of the farmers of this old Bay State as a parting injunction, it is *persevere*. Whatever of darkness and discouragement may surround you, — and there has been plenty of such in recent years, — lose not your courage! Farmers are awakening to the necessities of the situation all over the land. They may make mistakes; some of their notions may be chimerical or impractical at first; but right shall triumph in the end. A bright star of hope is in the distance before you; hold on and persevere. Sell not your farms to-day for a song, for to-morrow they will be wanted. Agriculture is too fundamental in its nature to ever go out of fashion, or long remain in depression. A close knowledge of public questions is needed by the farmers as a whole; free discussion of these questions will bring this knowledge. In a free country like ours, people to a large extent are self-educators. Therefore persevere.

### Business Principles.

Will farmers never learn the value of business principles? No accounts, no adequate value placed upon time, no system, unintentional dishonesty in little things. These are of altogether too frequent occurrence in farming communities. The exact opposites are considered as fundamental to success in other callings; and yet farming has to support some people, and their number is altogether too large, on these altogether inadequate foundations. As a result come abandoned farms, — farms that ought to be, farms that must be, and farms that will be, abandoned. There always was a pretty wide gulf between a poor farmer and a good one. That gulf to-day is becoming oceanic in its magnitude. The poor farmer must brace up, keep accounts, spend less

produce more, call business principles to his aid, and some day he will wake up to find that farming, even with him, pays.

### Industry.

I have said that farmers, too many of them, place no adequate value upon time. Point me to a single successful one among them, if you can, who does not value time and make the most of it. Industry is a habit, and it is one of the few good habits to be formed, and should be formed in youth. The industrious farmer will be up and doing in the morning, while his less successful neighbor still sleeps; and he will plan to keep himself and his hired help occupied during the day, and employed to advantage; and if he is a wise man, he will plan to do his work the easiest way, and make it count for all that it is worth. He will also do well that which he undertakes. It is not enough to produce a superior article; the article should be put up and sold in a superior manner. All the work is then of a superior quality, and a superior price is the result. The industrial habit is the first round to the ladder of success; like the first round in all ladders, it should be one of the strongest.

### Economy.

One of hardest lessons for every man to learn is that of economy. This, too, is a habit, and must be acquired; all the better if acquired in early life. It is an absolute essential to success in farming. The rule is inexorable: "Spend less than you earn, be the latter ever so little." We often wonder at the number of successful men who began life in poverty. I apprehend that the enforced lesson of doing with but little in early life was of incalculable value to them, indeed, was one of the corner-stones of the foundations of their success. No doubt they thought their lot in early life hard; no doubt they shrink from the thought that their children may be required to endure like hardships. Here is a point, however, worth considering. Is not the easiest way to succeed in any business, farming included, to begin at the bottom of the ladder and work up, — grow up with the business, as we say? The road looks long and

dreary to the impatient and ambitious youth; nevertheless, it is the easiest, and for this reason is fruitful of the greatest results.

Successful men seem to lose sight of this fact. They are prone to boast that their fortunes were made and their success established under great difficulties. They never had such chances as they propose to give their children. They had to work for their living just as soon as they were big enough to work. They had to practice self-denial all along the road. Industry and economy, — you will observe, — the two habits of all others essential to success, they were compelled to form. How about these children they propose to start in life on an improved plan? Are they industrious and economical? Undoubtedly they are, so far as their circumstances have taught them to be. But think you they know the value of every cent in a dollar, like the boy who has been obliged to earn it with his own hand, and then spend it in support of his aged or invalid parents? Or have they the slightest idea of economy, as compared with the forced self-denial endured by those in abject poverty? Oh, no. But the kind-hearted father proposes to give his sons an easier time than he himself had. So he divides his property, we will say $100,000, among four sons, — four sons brought up, educated and trained in a family where the annual income was that derived from $100,000. With $25,000 each they are sent forth upon the world to practice economy, live within their income, and add to their fortunes. The kind father expects them to do this, so does the world at large. Did the well-disposed father ever ask himself how he would succeed doing the same thing, — reducing his expenditures seventy-five per cent? It would not be very funny even for him, and the chances are ten to one that he would not do it, — pride would ruin him. But he expects his son to do it. Well, I do not say that the son cannot. It all depends upon his son's strength. But I do say that unless he has given that son exceptional training, such training as every father ought to give his son, in the care, management and expenditure of money, he gives him with this $25,000 a far more difficult task than he supposes, and one perhaps quite as difficult as he himself was ever called

upon to perform. I suppose that a man can lift an ox, if he will begin and lift the animal every day from a calf up; but if he should ask his son to go out and lift the ox without previous experience, all would depend upon the son's strength. He may succeed, but there are a good many chances against him. There is some chance for the exercise of charity, therefore, even with the rich.

Poverty, then, has some advantages as a birthplace, but is of no earthly use to those who have not the will, the courage and the endurance in them to rise out of their low estate. I by no means recommend it as an essential to success, I am only not insensible to its advantages. Nor would I be understood as implying that economy is by any means confined to the poor. There is the same relative economy in the case of the man who earns ten dollars and spends nine dollars as is manifested by the man who earns a thousand dollars and spends nine hundred dollars, — one-tenth of the income has been saved in either case. Or reverse the figures, and one tenth of the income has been squandered or lost. Economy is an all-important habit, not only for the financial success which must inevitably result from living within one's income, but the whole future is also valuable in the strength of character which such a course gives a man. It makes more of a man of him; and this is by no means a small consideration, when we consider success in life in its broadest sense. The economical man will look out especially for the thousand and one little leaks to which the farm is subject; and these little things may turn the scale, — indeed, they often have turned it from prospective failure to assured success.

## Virtue.

A high moral standard, freedom from vice and bad habits, are essentials to the highest success always. No less is this true among farmers than among other classes. Let us hope that New England farmers may never be less noted than they are at present in this respect of high standard, but that rather the future may be an improvement upon the past.

### Integrity.

"His word is as good as his bond;" "An honest man is the noblest work of God;" "Honesty is the best policy," — what a number of these sayings come to us, as we take up this important essential to success. Dollars and cents may come to the accumulative scoundrel, be he farmer or otherwise; but success, never. Self-respect and the confidence and respect of the community are essentials to happiness, and human happiness is the measure of success.

### Good Health.

Good health is the natural accompaniment of a good constitution, and is a highly important essential to success. Poor health cripples, delays and impairs bodily and mental action. There is no occupation more favorable to good health than farming. There is no purer air, no cleaner water, no better exercise to be had in the world than upon the farm; and yet statistics show that farmers are by no means the longest-lived people, which indicates that something is wrong somewhere. It is the duty of every one to not only look out for his own health, but also for that of his family as well. Doctors' bills are most expensive, and it is or should be a part of one's business to prevent the necessities which occasion them as far as possible. Many a farmer has been most seriously hampered by sickness in his family. This opens a subject for a whole essay in itself. I will allude to only a few of the bearings upon the case, and will name some of those less frequently touched upon.

In these days of modern improvements and cheap appliances, there is no reason why more conveniences should not be added to our farm-houses. The really comfortable farm house — comfortable in which to live or convenient in which to work — is still the exception rather than the rule in our country towns. This is true even upon the farms of those who in many ways are successful farmers, and who have the most approved modern barns and stables for their cattle. It is strange that wife and children, dearer than all else on earth to the farmer, have to wait for improvements to be supplied to the barn; and, if any money is spent for

the house, it is for a piano, a picture, a new front door, or some extra parlor furniture, too often instead of for some substantial improvement in the kitchen, like self-filling hot-water tanks, from which hot water may be drawn at the sink or in other parts of the house, a modern water-closet or bath room, a convenient cooking table, or a practical furnace or steam heater. How the inhabitant of the city dreads the country farm-house in winter, — particularly the cold, death-damp of the spare room and spare bed, — and well indeed he may, for these houses are responsible for many a sickness and death both of city and country people. Then, too, the unevenly heated house, associated with which are the cold, damp cellars, cold floors, here a cold room, there a warm one, sleeping rooms so cold that water will freeze in the pitchers at nights; privies, relics of the age of barbarism, — sick and well alike, to occupy them, passing from the atmosphere of a room heated by an air-tight stove to the cold chill of Greenland's snowy mountains and a block of ice.

Are such things healthful? The rugged may stand them, but how about the sickly and the weak? Can't afford anything different? Added to a little house planning and personal labor, the price of a silk dress or of one year's cigars will put a modern water-closet into any farm-house in this State. A similar expenditure will put in a wood furnace, and a like amount an improved copper boiler, with running hot water at the kitchen sink. The reason these are not added is because of dreaded expense. The fact is, they need not be expensive unless they are made so. Once in, these comforts would never be parted with for money, and our boys and girls would see just so much less of difference and attraction in city life. There is no reason to-day why city people should be comfortable and farmers' families miserable. Cost does not stand in the way. Action is all that is wanted. It is needless for me to caution against over-eating, over-drinking (especially ice water) or overwork. We all know better than to do such things, and yet we persist in doing them to a greater or less extent. Late hours are detrimental to health, yet how many people dissipate in this way.

Cleanliness is next to Godliness. Some people seem to be afraid of Godliness. The successful farmer will give especial care to the wells and springs from which drinking water is to be used, also to prevent or control all chance of impure and contaminating air floating past the dwelling of his family. A man should also be able to lay aside his business when night comes. "A good name is rather to be chosen than great riches." So is good health. It is a priceless boon, and it is sinful as well as unwise not to foster it to the best of our ability.

### Good Judgment.

I once knew a man who was a cripple, and yet, by the exercise of good judgment, together with some of the other good qualities which have been mentioned, he made farming pay, laid up money every year, and when he died left a respectable fortune. It is true that he had no family to support or educate; but many of his cotemporaries, able-bodied men, who were not possessed of good judgment, failed of success, and their farms have long since passed into other hands. Good judgment is, indeed, a blessing to any one. It is what our grandfathers called common sense, — a misnomer, indeed, for they meant good sense, good judgment.

### Executive Ability.

Without good executive ability, a man can do but little, even at farming. I like to see the farmer lead in his work; but it makes me ache to see a man do most of the work himself, and pay two or three hired men to see him do it, yet such is frequently the case among industrious farmers. That is a happy faculty indeed, and is a part of one's executive ability, that enables him to so handle men as to get the greatest possible amount of work out of them. Every one of good executive ability will at once recognize the value of system, and will adopt it in his work so far as is practicable under his circumstances. Large establishments cannot be run without system; small ones may, but not as profitably.

### Power to Say "No."

The power to say no is a powerful weapon, and a valuable

one in the hands of those who use it wisely. How singular it is that so few people have it, or at least have it under the control of will. Some people say no simply because they are naturally ugly, and take that way to vent their spleen. Such people have no more control of the word, however, than do those who don't dare to use it for fear of offending somebody. No man is a success, in so far as self-mastery goes, who has not acquired the art of saying no at the right time, in the right place, and in the right manner; kindly but firmly, no. The inability to do this has brought ruin upon the household of many a well-meaning and in many other respects successful farmer. What a harvest lightning-rod men, book agents, insurance agents, confidence men and sharpers of all grades have had throughout our rural districts. The power of saying no is valuable not only to be used against sharpers, but also against well-meaning calls for aid, for whatever object, whenever one is in a position where he cannot afford to give. It is no charity, neither is it religion, to steal money from creditors to give either for charitable or religious purposes. A farmer should also be so familiar with his affairs that he may know just how much he can afford to give. Few there are that cannot afford to give something. Too many either give just what they are asked to give, or else refuse altogether, thus wronging either themselves or their creditors on the one hand, or losing the benefits to be derived from the injunction that it is more blessed to give than to receive on the other.

Then, too, in the family itself, the art of saying no just right is a fine art. Upon the farm the wife as well as the husband should always know the condition of the finances. This is of more vital importance than many suspect. In regard to any matter which comes up that requires the expenditure of money, if judgment does not say yes, if there is the least doubt, a good rule is to say no. About ten times out of ten this will be right.

### The Family Relation.

And God said, "It is not good for man to be alone." I have saved, as the last essential to success upon the farm, the family relation, — last but not least. Without the family

New England farm life is no success. Whatever questions may have arisen in the past as to the profitableness of the business, no lament has ever gone forth as to the ability, the stamina and the character of the young men and women sent forth from New England farms. They are scattered over the world upon every land and in every clime, filling positions in life with credit to themselves and honor to their native land. They are the crowning glory of New England agriculture. Ask one of these to point to ideal happiness, and he will refer back to his early farm life, — his days in the public school, the old homestead, the unbroken semicircle, father, mother, brothers and sisters, — the ideal New England family, gathered before the old open fireplace. A distant look may take possession of his eye, and a tear drop may trickle down his cheek at the thought. Out of respect to that thought, let us leave him in his revery.

# AGRICULTURAL EXHIBITIONS, 1891.

AMESBURY and SALISBURY at *Amesbury*, September 29 and 30.

ATTLEBOROUGH at *North Attleborough*, September 29 and 30.

BAY STATE (holds no fair this year).

BARNSTABLE COUNTY at *Barnstable*, September 15 and 16.

BERKSHIRE at *Pittsfield*, September 15 and 16.

BLACKSTONE VALLEY at *Uxbridge*, September 29 and 30.

BRISTOL COUNTY at *Taunton*, October 7, 8 and 9.

DEERFIELD VALLEY at *Charlemont*, September 17 and 18.

EASTERN HAMPDEN at *Palmer*, September 22 and 23.

ESSEX at *Lawrence*, September 22 and 23.

FRANKLIN COUNTY at *Greenfield*, September 24 and 25.

HAMPDEN at *Westfield*, September 24 and 25.

HAMPSHIRE at *Amherst*, September 29 and 30.

HAMPSHIRE, FRANKLIN and HAMPDEN at *Northampton*, October 7 and 8.

HIGHLAND at *Middlefield*, September 9 and 10.

HILLSIDE at *Cummington*, September 29 and 30.

HINGHAM at *Hingham*, September 29 and 30.

HOOSAC VALLEY at *North Adams*, September 22, 23 and 24.

HOUSATONIC at *Great Barrington*, September 30 and October 1.

MASSACHUSETTS (holds no annual fair).

MASSACHUSETTS HORTICULTURAL at *Boston*, September 15, 16 and 17.

MARSHFIELD at *Marshfield*, September 16, 17 and 18.

MARTHA'S VINEYARD at *West Tisbury*, October 6 and 7.

MIDDLESEX at *Concord*, September 22 and 23.

MIDDLESEX NORTH at *Lowell*, September 29 and 30.

MIDDLESEX SOUTH at *Framingham*, September 16 and 17.

NANTUCKET at *Nantucket*, September 9 and 10.

OXFORD at *Oxford*, September 22 and 23.

PLYMOUTH COUNTY at *Bridgewater*, September 23, 24 and 25.

SPENCER at *Spencer*, October 1 and 2.

UNION at *Blandford*, September 16 and 17.

WEYMOUTH at *North Weymouth*, October 7, 8 and 9.

WORCESTER at *Worcester*, September 1, 2, 3 and 4.

WORCESTER EAST at *Lancaster*, September 17 and 18.

WORCESTER NORTH at *Fitchburg*, September 29 and 30.

WORCESTER NORTH-WEST at *Athol*, October 6 and 7.

WORCESTER SOUTH at *Sturbridge*, September 17 and 18.

WORCESTER COUNTY WEST at *Barre*, September 24 and 25.

# FINANCIAL RETURNS

AND

# ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

## INCORPORATED SOCIETIES,

WITH A DIRECTORY OF THE AGRICULTURAL AND SIMILAR ORGANIZATIONS IN THE STATE, CATTLE COMMISSION REPORT, ETC.

FINANCIAL RETURNS OF THE INCORPORATED

| SOCIETIES. | Amount raised by contribution, etc. (P. S., Chap. 114, Sects. 1 and 2.) | Amount now held invested as a Capital Stock. (P. S., Chap. 114, Sects. 2 and 10.) | Estimated Market Value of Real Estate. | Estimated Market Value of Personal Property. |
|---|---|---|---|---|
| Amesbury and Salisbury (Agricultural and Horticultural), | 1889 — $3,069 22 | $3,656 20 | 0 | $3,656 20 |
| Attleborough Agricultural Association, | 1890 — 20,000 00 | 20,000 00 | $19,500 00 | 500 00 |
| Barnstable County, | 1856 — 3,550 00 | 9,113 58 | 7,500 00 | 800 00 |
| Bay State, | 1888 — 2,177 16 | 577 97 | 0 | 0 |
| Berkshire, | 1853 — 3,000 00 | 15,000 00 | 15,000 00 | 0 |
| Blackstone Valley, | 1884 — 3,000 00 | 3,100 00 | 3,000 00 | 100 00 |
| Bristol County, | 1853 — 3,240 00 | 30,000 00 | 29,800 00 | 200 00 |
| Deerfield Valley, | 1871 — 4,094 01 | 8,739 89 | 7,000 00 | 405 00 |
| Eastern Hampden, | 1859 — 3,000 00 | 7,000 00 | 7,000 00 | 0 |
| Essex, | 1853 — 9,363 66 | 22,866 50 | 5,000 00 | 17,866 50 |
| Franklin County, | 1853 — 3,768 00 | 7,000 00 | 6,000 00 | 1,000 00 |
| Hampden, | 1853 — 4,860 00 | 1,018 37 | 0 | 0 |
| Hampshire, | 1853 — 3,255 26 | 2,650 00 | 2,500 00 | 150 00 |
| Hampshire, Franklin and Hampden, | 1853 — 8,141 29 | 8,925 00 | 8,800 00 | 125 00 |
| Highland, | 1861 — 3,262 00 | 1,100 00 | 1,000 00 | 100 00 |
| Hillside, | 1884 — 3,113 32 | 4,950 05 | 4,300 00 | 175 46 |
| Hingham (Agricultural and Horticultural), | 1867 — 17,406 15 | 22,000 00 | 20,000 00 | 2,000 00 |
| Hoosac Valley, | 1863 — 3,100 00 | 13,350 00 | 12,900 00 | 450 00 |
| Housatonic, | 1853 — 6,335 33 | 11,459 80 | 10,000 00 | 1,459 80 |
| Marshfield (Agricultural and Horticultural), | 1868 — 3,755 43 | 20,580 08 | 19,072 78 | 1,507 30 |
| Martha's Vineyard, | 1859 — 4,552 17 | 3,941 56 | 2,200 00 | 1,741 56 |
| Massachusetts, | - - | - | - | - |
| Massachusetts Horticultural, | 1885 — 180,000 00 | 247,000 00 | 250,000 00 | 12,000 00 |
| Middlesex, | 1853 — 3,000 00 | 15,100 00 | 15,000 00 | 100 00 |
| Middlesex North, | 1855 — 3,000 00 | 28,000 00 | 28,000 00 | 400 00 |
| Middlesex South, | 1854 — 3,500 00 | 15,200 00 | 15,000 00 | 200 00 |
| Nantucket, | 1864 — 3,500 00 | 3,200 00 | 3,200 00 | 0 |
| Oxford, | 1889 — 4,400 00 | 6,900 00 | 6,700 00 | 200 00 |
| Plymouth County, | 1853 — 9,550 00 | 45,000 00 | 43,000 00 | 2,000 00 |
| Spencer (Farmers' and Mechanics' Association), | 1888 — 8,650 00 | 7,800 00 | 7,000 00 | 800 00 |
| Union, | 1869 — 4,447 23 | 9,579 77 | 7,946 88 | 1,632 89 |
| Weymouth (Agricultural and Industrial), | 1890 — 10,270 00 | 10,270 00 | 10,000 00 | 270 00 |
| Worcester, | 1853 — 7,730 00 | 130,000 00 | 130,000 00 | 125 00 |
| Worcester East, | 1890 — 1,015 00 | 1,015 00 | 0 | 45 00 |
| Worcester North, | 1855 — 3,100 00 | 5,399 56 | 3,500 00 | 350 00 |
| Worcester North-west, | 1869 — 3,400 00 | 10,400 00 | 10,000 00 | 400 00 |
| Worcester South, | 1860 — 3,127 40 | 8,500 00 | 8,000 00 | 500 00 |
| Worcester County West, | 1853 — 3,175 00 | 12,600 00 | 11,600 00 | 1,000 00 |
| AGGREGATES, | - - | $772,993 43 | $729,519 66 | $52,259 81 |

*Investment of Capital Stock (P. S.,*

AMESBURY AND SALISBURY — Two mortgages and bank funds on interest.

ATTLEBOROUGH AGRICULTURAL ASSOCIATION — Land, buildings, furniture, fixtures, etc.

BARNSTABLE COUNTY — Real estate, notes, bonds, cash on hand.

BAY STATE — Cash in bank.

BERKSHIRE — Real estate.

BLACKSTONE VALLEY — Real estate.

BRISTOL COUNTY — Real estate, crockery, tables, etc.

DEERFIELD VALLEY — Real estate, crockery, tables, etc., bank funds.

EASTERN HAMPDEN — Real estate.

ESSEX — Real estate, notes, stocks, crockery, tables, etc.

Societies for the Year ending Dec. 1, 1890.

| Amount of Funds drawing Dividends or Interest. | Income from Funds drawing Dividends or Interest. | Amount of Bounty received from the Commonwealth. | Amount received from New Members. | Amount received as Donations. | Amount received from All Other Sources. | Total Amount of Receipts for the Year. | Total Amount of Premiums offered. |
|---|---|---|---|---|---|---|---|
| $3,201 30 | $148 65 | $428 45 | $24 00 | $70 25 | $1,221 97 | $1,893 32 | $1,099 25 |
| 0 | 0 | 0 | 0 | 0 | 6,322 67 | 6,322 67 | 800 00 |
| 800 00 | 22 00 | 600 00 | 30 00 | 137 80 | 5,490 83 | 6,280 63 | 1,781 00 |
| 0 | 0 | 600 00 | 20 00 | 0 | 6 00 | 626 00 | 0 |
| 0 | 0 | 600 00 | 100 00 | 1,096 00 | 4,047 77 | 5,843 77 | 2,856 00 |
| 0 | 0 | 600 00 | 43 00 | 16 00 | 1,083 73 | 1,742 73 | 893 25 |
| 0 | 0 | 600 00 | 20 00 | 80 15 | 12,186 76 | 12,286 91 | 5,000 00 |
| 0 | 0 | 600 00 | 128 00 | 39 32 | 938 28 | 1,705 60 | 905 75 |
| 0 | 0 | 600 00 | 46 00 | 121 18 | 1,323 10 | 2,120 28 | 1,878 25 |
| 16,666 50 | 734 15 | 600 00 | 189 00 | 1,000 00 | 1,142 84 | 3,665 99 | 3,000 00 |
| 1,200 00 | 64 44 | 600 00 | 105 00 | 6 00 | 1,534 30 | 2,309 74 | 1,338 75 |
| 1,018 37 | 39 52 | 600 00 | 30 00 | 266 51 | 689 29 | 1,625 32 | 1,844 00 |
| 0 | 0 | 600 00 | 55 00 | 0 | 148 03 | 803 03 | 908 00 |
| 0 | 0 | 600 00 | 91 00 | 0 | 2,540 85 | 3,231 85 | 1,309 50 |
| 0 | 0 | 600 00 | 37 00 | 0 | 1,014 64 | 1,651 64 | 756 80 |
| 0 | 0 | 600 00 | 157 00 | 34 15 | 769 67 | 1,560 82 | 700 00 |
| 0 | 0 | 600 00 | 292 00 | 99 60 | 1,992 82 | 2,984 42 | 1,819 25 |
| 0 | 0 | 600 00 | 715 00 | 0 | 5,056 49 | 6,371 49 | 1,853 00 |
| 1,459 80 | 52 42 | 600 00 | 91 00 | 0 | 4,334 89 | 5,078 31 | 3,281 00 |
| 0 | 0 | 600 00 | 65 00 | 230 59 | 2,208 33 | 3,103 92 | 1,050 00 |
| 1,591 56 | 86 21 | 600 00 | 40 00 | 20 00 | 679 13 | 1,425 34 | 767 00 |
| – | – | – | – | – | – | – | – |
| 8,500 00 | 576 13 | 600 00 | 410 00 | 0 | 36,618 24 | 38,204 37 | 6,478 00 |
| 0 | 0 | 0 | 0 | 0 | 2 37 | 2 37 | 0 |
| 0 | 0 | 600 00 | 234 00 | 0 | 4,683 00 | 5,517 00 | 1,795 00 |
| 0 | 0 | 600 00 | 40 00 | 71 35 | 1,124 29 | 1,835 64 | 838 85 |
| 0 | 0 | 595 17 | 37 00 | 6 00 | 857 32 | 1,495 49 | 1,562 50 |
| 0 | 0 | 600 00 | 79 00 | 144 25 | 1,758 02 | 2,581 27 | 1,500 00 |
| 0 | 0 | 600 00 | 31 00 | 111 95 | 8,631 24 | 9,374 19 | 3,941 50 |
| 0 | 0 | 600 00 | 245 00 | 677 44 | 2,708 21 | 4,230 65 | 1,879 50 |
| 100 00 | 32 12 | 600 00 | 70 00 | 10 00 | 2,404 57 | 3,116 60 | 1,758 50 |
| 0 | 0 | 0 | 10 00 | 5 30 | 2,856 77 | 2,872 07 | 749 00 |
| 2,837 01 | 103 14 | 600 00 | 550 00 | 0 | 33,039 56 | 34,292 70 | 10,512 50 |
| 970 00 | 29 28 | 0 | 171 00 | 447 25 | 2,455 90 | 3,303 43 | 1,402 50 |
| 0 | 0 | 600 00 | 79 00 | 25 00 | 3,857 22 | 4,561 22 | * |
| 0 | 0 | 600 00 | 87 50 | 0 | 3,500 21 | 4,187 71 | 2,380 50 |
| 0 | 0 | 600 00 | 72 00 | 0 | 2,631 79 | 3,303 79 | 2,662 00 |
| 0 | 0 | 600 00 | 60 00 | 70 59 | 1,441 33 | 2,171 92 | 1,587 60 |
| $38,344 54 | $1,888 06 | $19,623 62 | $4,453 50 | $4,786 68 | $163,302 43 | $193,684 29 | $72,888 75 |

* No fixed sum.

*Chap. 114, Sects. 2 and 10.)*

Franklin County — Real estate and bank stock.
Hampden — Bank funds.
Hampshire — Real estate, crockery, tables, etc.
Hampshire, Franklin and Hampden — Real estate, crockery, tables, etc.
Highland — Buildings, land, fence and track.
Hillside — Land, buildings, fixtures and cash.
Hingham — Land, buildings, furniture, etc.
Hoosac Valley — Real estate, crockery, tables, etc.
Housatonic — Real estate, railroad stocks, bank deposit.
Marshfield — Real estate, crockery, tables, etc.

FINANCIAL RETURNS OF THE INCORPORATED

| SOCIETIES. | Total Amount of Premiums and Gratuities awarded. | Total Amount of Premiums and Gratuities paid. | Current running Expenses. | Interest paid. |
|---|---|---|---|---|
| Amesbury and Salisbury (Agricultural and Horticultural), | $562 05 | $526 00 | $63 66 | 0 |
| Attleborough Agricultural Association, | 764 65 | 673 40 | 350 00 | $243 64 |
| Barnstable County, | 1,446 10 | 1,446 10 | 1,283 68 | 68 75 |
| Bay State, | 0 | 0 | 56 96 | 0 |
| Berkshire, | 2,327 25 | 2,327 25 | 2,406 89 | 564 46 |
| Blackstone Valley, | 729 49 | 729 49 | 740 76 | 10 00 |
| Bristol County, | 4,041 93 | 3,938 78 | 4,643 19 | 1,080 00 |
| Deerfield Valley, | 802 00 | 800 00 | 800 43 | 0 |
| Eastern Hampden, | 1,127 15 | 1,127 15 | 612 85 | 90 52 |
| Essex, | 1,646 00 | 1,548 25 | 764 88 | 21 66 |
| Franklin County, | 1,085 00 | [1]1,097 25 | 1,374 35 | 0 |
| Hampden, | 1,023 35 | 843 93 | 846 02 | 0 |
| Hampshire, | 611 00 | 611 00 | 846 01 | 51 69 |
| Hampshire, Franklin and Hampden, | 1,062 25 | 939 25 | 941 69 | 200 00 |
| Highland, | 610 50 | 610 50 | 960 18 | 16 20 |
| Hillside, | 720 05 | 685 90 | 395 33 | 0 |
| Hingham (Agricultural and Horticultural), | 710 99 | 710 99 | 1,361 70 | 136 65 |
| Hoosac Valley, | 1,307 50 | 1,307 50 | 2,865 81 | 61 25 |
| Housatonic, | 2,702 00 | 2,645 75 | 2,257 48 | 0 |
| Marshfield (Agricultural and Horticultural), | 927 68 | 792 68 | 852 82 | 322 50 |
| Martha's Vineyard, | 610 98 | 610 98 | 338 13 | 0 |
| Massachusetts, | - | - | - | - |
| Massachusetts Horticultural, | 6,070 04 | 5,954 04 | 30,547 69 | 1,085 00 |
| Middlesex, | 0 | 0 | 0 | 0 |
| Middlesex North, | 922 70 | 1,081 37 | 1,245 03 | 202 91 |
| Middlesex South, | 793 95 | 793 95 | 682 95 | 366 18 |
| Nantucket, | 667 20 | 610 35 | 689 32 | 0 |
| Oxford, | 1,021 75 | 995 25 | 350 61 | 100 00 |
| Plymouth County, | 3,066 50 | 3,066 50 | 5,575 09 | 417 91 |
| Spencer (Farmers' and Mechanics' Association), | 1,613 00 | 1,582 16 | 1,458 53 | 136 31 |
| Union, | 1,201 60 | 1,154 38 | 823 45 | 53 |
| Weymouth (Agricultural and Industrial), | 497 00 | 463 55 | 2,179 52 | 181 35 |
| Worcester, | 8,225 79 | 8,225 79 | 2,663 80 | 1,905 50 |
| Worcester East, | 998 25 | 776 88 | 2,320 04 | 0 |
| Worcester North, | 1,859 80 | 1,716 30 | 2,517 58 | 0 |
| Worcester North-west, | 1,699 85 | 1,633 12 | 1,375 84 | 109 28 |
| Worcester South, | 2,135 75 | 1,980 25 | 1,333 85 | 160 41 |
| Worcester County West, | 1,276 95 | 1,106 36 | 835 77 | 0 |
| AGGREGATES, | $56,868 05 | $55,112 40 | $79,561 89 | $7,532 70 |

[1] $65.50 of this amount was for 1889.

*Investment of Capital Stock (P. S.,*

MARTHA'S VINEYARD — Real estate, notes, crockery, tables, etc., savings bank.

MASSACHUSETTS —

MASSACHUSETTS HORTICULTURAL — Real estate, fixtures, bonds, library.

MIDDLESEX — Real estate, crockery, tables, etc.

MIDDLESEX NORTH — Real estate, crockery, tables, etc.

MIDDLESEX SOUTH — Real estate, crockery, tables, etc.

NANTUCKET — Grounds and buildings.

OXFORD — Park, buildings, track, wood land, crockery, tables, etc.

PLYMOUTH COUNTY — Real estate, crockery, tables, etc.

SOCIETIES FOR THE YEAR ENDING DEC. 1, 1890 — Concluded.

| Other Expenses. | Aggregate Expenses for the Year. | Cash on Hand. | Bills Due and Unpaid. | Aggregate Assets. | Premiums Due and Unpaid. | Outstanding Bills. | Mortgaged or like Liabilities. | Aggregate Liabilities. |
|---|---|---|---|---|---|---|---|---|
| $653 27 | $1,242 93 | $30 26 | $66 00 | $3,752 56 | $36 00 | $25 00 | 0 | $61 00 |
| 4,766 45 | 6,033 49 | 289 18 | 0 | 20,289 18 | 91 25 | [1]250 00 | $7,350 00 | 7,691 25 |
| 2,668 52 | 5,467 05 | 813 58 | 0 | 9,113 58 | 0 | 0 | 3,000 00 | 3,000 00 |
| 123 79 | 180 75 | 577 97[2] | 0 | 577 97 | 0 | 17 71 | 0 | 17 71 |
| 1,558 10 | 6,856 70 | 95 06 | 0 | 15,095 06 | 528 75 | 1,021 56 | 7,800 00 | 9,350 31 |
| 400 00 | 1,880 25 | 227 57 | 0 | 3,327 57 | 0 | 0 | 0 | 0 |
| 4,067 62 | 13,729 59 | 369 95 | 0 | 30,369 95 | 103 15 | 0 | 18,600 00 | 18,703 15 |
| 104 80 | 1,705 23 | 37 | 10 00 | 8,750 26 | 2 00 | 48 00 | 0 | 50 00 |
| 225 00 | 2,055 52 | 100 08 | 0 | 7,100 08 | 0 | 0 | 1,975 00 | 1,975 00 |
| 0 | 2,334 79 | 0 | 0 | 22,866 50 | 0 | 177 01 | 0 | 177 01 |
| 0 | 2,471 60 | 40 54 | 31 00 | 7,276 54 | 53 25 | [1]50 00 | 0 | 103 25 |
| 0 | 1,689 95 | 180 51 | 0 | 1,198 88 | 0 | 0 | 0 | 0 |
| 0 | 1,508 70 | 75 34 | 0 | 2,725 34 | 0 | 0 | 750 00 | 750 00 |
| 1,059 75 | 3,140 69 | 91 16 | 78 10 | 9,094 26 | 15 00 | 5 00 | 5,053 00 | 5,073 00 |
| 45 00 | 1,631 88 | 19 76 | 0 | 1,119 76 | 0 | 0 | 195 00 | 195 00 |
| 5 00 | 1,086 23 | 474 59 | 0 | 4,950 05 | 0 | 0 | 0 | 0 |
| 222 20 | 2,431 54 | 439 92 | 0 | 22,439 92 | 0 | 0 | 2,100 00 | 2,100 00 |
| 1,635 00 | 5,869 56 | 286 74[3] | 0 | 13,636 74 | 0 | 0 | 600 00 | 600 00 |
| 0 | 4,903 23 | 152 57 | 0 | 11,612 37 | 60 50 | [1]137 00 | 1,335 29 | 1,532 79 |
| 839 16 | 2,880 81 | 70 86 | 0 | 20,650 94 | 135 00 | 206 07 | 5,000 00 | 5,341 07 |
| 0 | 949 11 | 78 31 | 0 | 4,019 87 | 0 | 21 82 | 0 | 21 82 |
| - | - | - | - | - | - | - | - | - |
| 0 | 37,586 73 | 7,293 19 | 0 | 269,293 19 | 116 00 | 0 | 15,000 00 | 15,116 00 |
| 12 45 | 12 45 | 97 33 | 0 | 15,097 33 | 0 | 0 | 22,480 00 | 22,480 00 |
| 761 92 | 3,291 23 | 1,081 37 | 0 | 29,481 37 | 250 00 | 50 00 | 4,000 00 | 4,300 00 |
| 0 | 1,843 08 | 0 | 0 | 15,200 00 | 0 | 7 46 | 7,300 00 | 7,307 46 |
| 0 | 1,299 67 | 88 82 | 0 | 3,288 82 | 0 | 0 | 0 | 0 |
| 1,061 56 | 2,507 42 | 73 85 | 0 | 6,973 85 | 0 | 0 | 2,000 00 | 2,000 00 |
| 314 69 | 9,374 19 | 0 | 0 | 45,000 00 | 0 | 2,500 58 | 5,000 00 | 7,500 58 |
| 1,073 44 | 4,250 44 | 39 70 | 0 | 7,839 70 | 0 | 0 | 2,600 00 | 2,600 00 |
| 1,027 82 | 3,006 18 | 23 51 | 9 00 | 9,612 28 | 26 00 | 0 | 600 00 | 626 00 |
| 52 60 | 2,877 02 | 0 | 11 00 | 10,281 00 | 0 | 12 95 | 3,125 00 | 3,137 95 |
| 18,660 60 | 31,455 69 | 0 | 0 | 132,962 01 | 0 | 0 | 44,000 00 | 44,000 00 |
| 0 | 3,168 26 | 81 17 | 22 75 | 1,118 92 | 0 | 0 | 0 | 0 |
| 0 | 4,233 88 | 1,549 56 | 0 | 5,399 56 | 15 00 | 35 00 | 0 | 50 00 |
| 0 | 3,118 24 | 247 77 | 0 | 10,647 77 | 0 | 0 | 900 00 | 900 00 |
| 217 17 | 3,691 68 | 132 49 | 0 | 8,632 49 | 155 50 | 0 | 2,515 00 | 2,670 50 |
| 0 | 1,942 13 | 411 13 | 0 | 13,011 13 | 0 | 0 | 0 | 0 |
| $41,555 91 | $183,707 89 | $15,534 21 | $227 85 | $803,806 80 | $1,587 40 | $4,565 16 | $163,278 29 | $169,430 85 |

[1] Estimated. [2] In bank. [3] $113.25 of this was value of silver on hand.

*Chap. 114, Sects. 2 and 10.)*

SPENCER — Real estate, crockery, tables, etc.
UNION — Grounds, hall, barns, furniture and fixtures, notes, bank funds.
WEYMOUTH — Real estate, crockery, tables, etc.
WORCESTER — Real estate.
WORCESTER EAST — Bank funds and furniture.
WORCESTER NORTH — Real estate, crockery, tables, etc., cash on hand.
WORCESTER NORTH-WEST — Real estate, crockery, tables, etc.
WORCESTER SOUTH — Real estate, crockery, tables, etc.
WORCESTER COUNTY WEST — Real estate, crockery, tables, etc.

ANALYSES OF PREMIUMS AND GRATUITIES

| SOCIETIES. | Amount offered under Head of Farms, etc. | Amount awarded under Head of Farms, etc. | Amount paid out under Head of Farms, etc. | Amount offered under Head of Farm Stock. | Amount awarded under Head of Farm Stock. | Amount paid out under Head of Farm Stock. | Amount offered under Head of Field and Experimental Crops. | Amount awarded under Head of Field and Experimental Crops. |
|---|---|---|---|---|---|---|---|---|
| Amesbury and Salisbury,[1] . . . . | $103 00 | $35 00 | $35 00 | $468 00 | $187 00 | $181 00 | $120 00 | - |
| Attleborough Agricultural Association, . | - | - | - | 453 00 | 352 00 | 336 00 | - | - |
| Barnstable County, . | 125 00 | 25 00 | 25 00 | 518 75 | 377 50 | 377 50 | 136 00 | 55 00 |
| Bay State,[2] . . . | - | - | - | - | - | - | - | - |
| Berkshire, . . . | 41 00 | 38 00 | 38 00 | 1,536 00 | 948 00 | 713 00 | - | - |
| Blackstone Valley, . | 107 00 | 100 00 | 100 00 | 557 50 | 457 50 | 457 50 | 10 50 | 6 00 |
| Bristol County, . . | 244 00 | 83 00 | 83 00 | 1,529 00 | 1,201 00 | 1,201 00 | 235 00 | 23 00 |
| Deerfield Valley, . . | - | - | - | 600 00 | 531 00 | 531 00 | - | - |
| Eastern Hampden, . | 98 00 | - | - | 735 00 | 465 00 | 465 00 | 107 50 | 54 75 |
| Essex, . . . . . | 356 00 | 143 00 | 115 00 | 1,650 00 | 744 00 | 718 00 | 505 00 | 80 00 |
| Franklin County, . . | 10 00 | - | - | 914 75 | 721 50 | 679 50 | - | - |
| Hampden, . . . . | 326 00 | 12 00 | 10 00 | 891 00 | 497 75 | 369 75 | 109 00 | - |
| Hampshire, . . . . | 16 00 | - | - | 389 00 | 367 00 | 367 00 | 38 00 | 14 00 |
| Hampshire, Franklin and Hampden, . . | 20 00 | - | - | 799 00 | 713 00 | 636 75 | 70 00 | 57 00 |
| Highland, . . . . | - | - | - | 506 50 | 386 25 | 386 25 | 47 00 | 40 00 |
| Hillside, . . . . . | 40 00 | 39 00 | 39 00 | 455 00 | 420 00 | 420 00 | 28 00 | 28 00 |
| Hingham,[1] . . . | 220 00 | 12 00 | 12 00 | 945 95 | 488 80 | 488 80 | 93 00 | - |
| Hoosac Valley, . . | 80 00 | 71 00 | 71 00 | 873 50 | 578 25 | 578 25 | 196 00 | 188 00 |
| Housatonic, . . . | 64 00 | 64 00 | 56 00 | 1,386 00 | 1,065 00 | 1,046 50 | 288 00 | 287 00 |
| Marshfield,[1] . . . | 111 00 | - | - | 451 50 | 375 50 | 309 50 | 84 00 | 4 00 |
| Martha's Vineyard, . | 35 00 | - | 5 75 | 365 25 | 241 50 | 241 50 | 149 00 | 49 00 |
| Massachusetts,[3] . . | - | - | - | - | - | - | - | - |
| Massachusetts Horticultural, . . . | 300 00 | 135 00 | 210 00[4] | - | - | - | - | - |
| Middlesex,[2] . . . | - | - | - | - | - | - | - | - |
| Middlesex North, . . | - | - | - | 723 00 | 347 75 | 281 75 | 23 00 | 14 50 |
| Middlesex South, . . | 78 00 | 21 00 | 21 00 | 513 50 | 185 50 | 185 50 | 105 00 | 25 00 |
| Nantucket, . . . | 205 00 | 29 00 | 29 00 | 815 50 | 346 00 | 342 00 | 187 00 | 17 00 |
| Oxford, . . . . . | 65 00 | 45 00 | 42 50 | 838 00 | 581 00 | 562 60 | 44 00 | 36 75 |
| Plymouth County, . | 147 00 | 58 00 | 58 00 | 1,012 00 | 735 00 | 735 00 | 78 00 | 51 00 |
| Spencer (Farmers' and Mechanics' Association), . . . . | 79 00 | 54 00 | 54 00 | 1,164 00 | 730 00 | 721 00 | 66 50 | 31 50 |
| Union, . . . . . | 11 00 | 5 00 | 5 00 | 883 75 | 557 50 | 527 80 | 82 50 | 43 50 |
| Weymouth (Agricultural and Industrial), . | - | - | - | 330 05 | 294 55 | 290 55 | - | - |
| Worcester, . . . . | - | 135 00 | - | 5,343 00 | 3,781 14 | 3,781 14 | 151 00 | 123 00 |
| Worcester East, . . | 36 00 | 31 00 | 31 00 | 813 00 | 559 00 | 453 88 | - | - |
| Worcester North, . . | 44 00 | 35 00 | 31 00 | 872 00 | 391 00 | 292 50 | - | - |
| Worcester North-west, . | 61 00 | 31 00 | 31 00 | 1,111 50 | 656 25 | 627 34 | - | - |
| Worcester South, . . | 161 00 | 61 00 | 61 00 | 1,379 00 | 1,055 50 | 1,018 00 | 53 00 | 50 25 |
| Worcester County West, | 100 00 | 32 00 | 24 50 | 752 00 | 507 00 | 482 00 | 19 00 | 6 75 |
| AGGREGATES, . . | $3,283 00 | $1,294 00 | $1,187 75 | $32,475 00 | $21,844 74 | $20,804 86 | $3,025 00 | $1,285 00 |

[1] Agricultural and horticultural. [2] Held no fair. [3] Holds no annual fair. [4] For 1889.

FOR THE YEAR ENDING JAN. 1, 1891.

| Amount paid out under Head of Field and Experimental Crops. | Amount offered under Head of Farm and Garden Products. | Amount awarded under Head of Farm and Garden Products. | Amount paid out under Head of Farm and Garden Products. | Amount offered under Head of Dairy Products. | Amount awarded under Head of Dairy Products. | Amount paid out under Head of Dairy Products. | Amount offered under Head of Domestic Manufactures. | Amount awarded under Head of Domestic Manufactures. | Amount paid out under Head of Domestic Manufactures. |
|---|---|---|---|---|---|---|---|---|---|
| - | $177 50 | $128 80 | $117 25 | $4 25 | $3 25 | $3 25 | $97 75 | $62 50 | $54 50 |
| - | 274 00 | 230 25 | 213 25 | 5 00 | 5 00 | 5 00 | 142 75 | 135 90 | 125 45 |
| $55 00 | 229 50 | 191 25 | 191 25 | 19 00 | 18 00 | 18 00 | 118 75 | 122 35 | 122 35 |
| - | - | - | - | - | - | - | - | - | - |
| - | 346 00 | 248 00 | 163 00 | 55 00 | 52 00 | 46 25 | 298 00 | 271 00 | 199 00 |
| 6 00 | 72 00 | 55 50 | 55 50 | 7 50 | 7 50 | 7 50 | 83 75 | 46 25 | 46 25 |
| 23 00 | 400 00 | 256 00 | 256 00 | 50 00 | 45 00 | 45 00 | 250 00 | 263 50 | 263 50 |
| - | 70 00 | 63 25 | 63 25 | 14 50 | 14 50 | 14 50 | 68 15 | 59 65 | 59 65 |
| 54 75 | 52 00 | 53 50 | 53 50 | 20 00 | 14 00 | 14 00 | 63 75 | 53 85 | 53 85 |
| 71 00 | 645 00 | 489 50 | 396 50 | 51 00 | 18 00 | 18 00 | 200 00 | 166 25 | 168 25 |
| - | 214 00 | 185 75 | 180 75 | 20 00 | 16 00 | 16 00 | 138 00 | 140 75 | 130 75 |
| - | 214 50 | 199 00 | 145 52 | 36 00 | 10 00 | 8 50 | 103 50 | 108 00 | 62 00 |
| 14 00 | 130 00 | 70 00 | 70 00 | 10 00 | 5 00 | 5 00 | 87 00 | 68 65 | 68 65 |
| 57 00 | 206 50 | 134 50 | 94 50 | 44 00 | 28 00 | 28 00 | 153 50 | 139 75 | 112 00 |
| 40 00 | 23 25 | 32 55 | 32 55 | 9 00 | 8 25 | 8 25 | 52 00 | 64 00 | 64 00 |
| 28 00 | 75 00 | 88 00 | 88 00 | 21 00 | 20 75 | 20 75 | 63 00 | 57 50 | 57 50 |
| - | 403 95 | 173 30 | 173 30 | 20 00 | 13 00 | 13 00 | 90 00 | 78 50 | 78 50 |
| 188 00 | 184 50 | 133 25 | 133 25 | 56 00 | 43 50 | 43 50 | 219 00 | 199 75 | 199 75 |
| 278 00 | 284 00 | 249 50 | 248 50 | 46 00 | 46 00 | 46 00 | 431 00 | 368 50 | 349 50 |
| 3 75 | 228 00 | 191 45 | 126 75 | 27 00 | 24 00 | 24 00 | 177 00 | 177 53 | 176 46 |
| 48 00 | 76 00 | 73 30 | 73 30 | 12 50 | 12 00 | 12 00 | 82 50 | 82 55 | 82 55 |
| - | - | - | - | - | - | - | - | - | - |
| - | 6,851 75 | 6,534 00 | [1] 5,480 63 | - | - | - | - | - | - |
| - | - | - | - | - | - | - | - | - | - |
| 14 50 | 411 00 | 333 50 | 263 50 | 10 00 | 10 00 | 7 00 | 192 00 | 140 70 | 117 15 |
| 25 00 | 169 00 | 96 15 | 96 15 | 6 00 | 3 00 | 3 00 | 57 25 | 41 50 | 41 50 |
| 17 00 | 194 00 | 81 00 | 81 00 | 21 00 | 9 00 | 9 00 | 140 00 | 108 20 | 80 15 |
| 36 50 | 25 50 | 19 25 | 19 06 | 15 00 | 11 00 | 11 00 | 26 00 | 26 00 | 23 31 |
| 51 00 | 261 50 | 197 40 | 197 40 | 41 00 | 40 00 | 40 00 | 178 00 | 143 10 | 143 10 |
| 30 50 | 73 75 | 73 00 | 70 25 | 15 00 | 11 00 | 11 00 | 75 25 | 49 50 | 42 50 |
| 42 25 | 43 00 | 38 25 | 38 12 | 17 00 | 13 00 | 13 00 | 109 00 | 86 10 | 72 84 |
| - | 128 35 | 113 80 | 100 65 | 7 50 | 2 50 | 1 50 | 89 85 | 71 40 | 58 65 |
| 123 00 | 747 00 | 623 93 | 623 93 | 116 00 | 116 00 | 116 00 | 162 75 | 109 75 | 109 75 |
| - | 276 50 | 229 25 | 165 00 | 12 00 | 9 00 | 9 00 | 94 00 | 64 00 | 46 00 |
| - | 152 50 | 222 90 | 211 60 | 8 50 | 5 00 | 3 00 | 85 50 | 89 45 | 64 45 |
| - | 139 50 | 94 50 | 85 25 | 23 00 | 16 00 | 14 33 | 62 00 | 49 10 | 42 20 |
| 47 00 | 126 50 | 84 75 | 56 50 | 42 00 | 35 00 | 35 00 | 155 50 | 82 75 | 68 75 |
| 6 75 | 99 60 | 40 05 | 15 51 | 15 00 | 14 00 | 12 00 | 62 00 | 40 15 | 33 60 |
| $1,260 00 | $14,005 15 | $12,028 38 | $10,380 47 | $876 75 | $698 25 | $681 33 | $4,408 50 | $3,768 43 | $3,421 41 |

[1] For 1889.

ANALYSIS OF PREMIUMS AND GRATUITIES — MEMBERSHIP,

| SOCIETIES. | Amount awarded for Agricultural Implements. | Amount paid out for Same. | Amount awarded for All Other Objects strictly Agricultural, not already classified. | Amount paid out for Same. | Amount awarded for Trotting. | Amount paid out for Same. |
|---|---|---|---|---|---|---|
| Amesbury and Salisbury,[1] | $26 00 | $26 00 | $5 00 | $4 00 | - | - |
| Attleborough Agricultural Association, | - | - | - | - | $2,100 00 | $1,830 00 |
| Barnstable County, | - | - | - | - | 685 00 | 635 00 |
| Bay State,[2] | - | - | - | - | - | - |
| Berkshire, | 64 00 | 36 00 | - | - | 1,105 00 | 1,030 00 |
| Blackstone Valley, | - | - | - | - | - | - |
| Bristol County, | - | - | - | - | 2,058 00 | 1,983 75 |
| Deerfield Valley, | [4] - | [4] - | 28 50 | 28 50 | 50 00 | 50 00 |
| Eastern Hampden, | - | - | - | - | 450 00 | 450 00 |
| Essex, | 50 00 | 50 00 | - | - | - | - |
| Franklin County, | [4] - | [4] - | - | - | 345 00 | 326 50 |
| Hampden, | 20 00 | 10 00 | - | - | 130 00 | 130 00 |
| Hampshire, | 5 00 | 5 00 | 4 00 | 4 00 | 236 00 | 236 00 |
| Hampshire, Franklin and Hampden, | 25 00 | 22 50 | - | - | 505 00 | 505 00 |
| Highland, | 1 00 | 1 00 | - | - | 32 00 | 32 00 |
| Hillside, | 6 00 | - | - | - | - | - |
| Hingham,[1] | - | - | - | - | - | - |
| Hoosac Valley, | 7 75 | 7 75 | - | - | 1,635 00 | 1,635 00 |
| Housatonic, | 1 50 | 1 50 | - | - | 615 25 | 615 25 |
| Marshfield,[1] | - | - | - | - | 200 00 | 200 00 |
| Martha's Vineyard, | - | - | - | - | - | - |
| Massachusetts,[3] | - | - | - | - | - | - |
| Massachusetts Horticultural, | - | - | - | - | - | - |
| Middlesex,[2] | - | - | - | - | - | - |
| Middlesex North, | [4] - | [4] - | - | - | 360 00 | 360 00 |
| Middlesex South, | - | - | 20 00 | 20 00 | 387 00 | 387 00 |
| Nantucket, | - | - | - | - | - | - |
| Oxford, | 5 00 | 4 00 | - | - | 275 00 | 275 00 |
| Plymouth County, | - | - | - | - | 1,775 00 | 1,775 00 |
| Spencer (Farmers' and Mechanics' Association), | 25 00 | 22 00 | - | - | 610 00 | 610 00 |
| Union, | - | - | 84 00 | 84 00 | 352 00 | 352 00 |
| Weymouth (Agricultural and Industrial), | - | - | - | - | 500 00 | 500 00 |
| Worcester, | [4] - | [4] - | - | - | 2,552 50 | 2,552 00 |
| Worcester East, | 19 00 | 19 00 | - | - | - | - |
| Worcester North, | 30 00 | 29 50 | - | - | 1,130 00 | 990 00 |
| Worcester North-west, | 16 00 | 16 00 | - | - | 784 00 | 784 00 |
| Worcester South, | 15 00 | 15 00 | 50 00 | 50 00 | 665 00 | 665 00 |
| Worcester County West, | 7 00 | 2 00 | - | - | 530 00 | 530 00 |
| AGGREGATES, | $323 25 | $267 25 | $191 50 | $190 50 | $20,066 75 | $19,438 50 |

[1] Agricultural and horticultural. [2] Held no fair. [3] Holds no fair. [4] Diplomas.

INSTITUTES, FOR THE YEAR ENDING JAN. 1, 1891 — Concluded.

| Amount awarded for Objects Other than Agricultural, not already classified. | Amount paid out for Same. | Number of Persons who received Premiums. | Number of Persons who received Gratuities. | Number of Towns to which the Premiums and Gratuities were disbursed. | Amount of Premiums and Gratuities disbursed within the Commonwealth. | Amount of Premiums and Gratuities disbursed outside the Commonwealth. | Number of Male Members. | Number of Female Members. | Total Membership. | Number of Institutes held during Year. |
|---|---|---|---|---|---|---|---|---|---|---|
| $114 50 | $105 00 | 138 | 71 | 14 | $503 30 | $231 00 | 126 | 5 | 131 | 3 |
| 41 50 | 38 00 | 231 | 77 | 25 | 569 65 | 195 30 | 94 | 6 | [1]100 | 3 |
| 24 00 | 24 00 | [2]289 | - | 11 | 1,346 13 | 100 00 | - | - | 768 | 3 |
| - | - | - | - | - | - | - | - | - | 437 | 4 |
| 130 00 | 130 00 | 414 | - | [3]23 | 2,138 25 | 717 75 | 1,193 | 75 | 1,268 | 3 |
| 55 74 | 55 74 | 264 | 20 | 14 | 728 74 | 75 | 229 | 132 | 361 | 3 |
| 112 43 | 83 51 | 400 | 120 | 20 | 1,789 00 | 109 00 | [4]700 | [4]300 | [4]1,000 | 4 |
| 55 10 | 55 10 | 302 | - | - | - | - | 1,133 | 294 | 1,427 | 5 |
| 36 75 | 36 75 | [2]143 | - | 18 | 1,127 85 | - | 329 | 237 | [1]566 | 3 |
| 105 00 | 109 25 | 417 | - | 33 | 1,811 75 | - | 1,499 | 8 | 1,507 | 6 |
| 22 00 | 22 00 | 314 | 3 | 18 | 1,029 00 | - | [4]2,000 | [4]500 | 2,500 | 4 |
| 46 25 | 17 63 | 147 | - | 14 | 843 93 | - | 769 | 182 | 951 | 3 |
| 25 00 | 25 00 | 93 | 40 | 13 | 611 00 | - | - | - | - | 3 |
| 15 00 | 10 50 | [2]214 | - | 27 | 961 25 | - | 800 | 173 | 973 | 3 |
| 46 45 | 46 45 | 187 | 7 | 23 | 608 60 | 1 90 | 340 | 135 | 475 | 3 |
| 43 00 | - | 362 | - | 16 | 685 90 | - | 506 | 16 | 522 | 3 |
| 38 00 | 38 00 | 126 | 317 | 22 | 803 35 | 25 | 481 | 220 | 701 | 6 |
| 86 00 | 86 00 | 295 | - | 16 | 1,128 50 | 179 00 | 898 | 15 | 913 | 3 |
| - | - | 451 | - | - | - | - | 1,642 | 45 | 1,687 | 4 |
| - | - | 93 | 265 | 26 | 970 26 | 50 | 563 | 302 | 865 | 3 |
| 146 88 | 146 88 | 106 | 170 | 4 | 610 98 | - | 142 | 91 | 233 | 3 |
| - | - | - | - | - | - | - | - | - | - | - |
| - | - | [5]148 | [5]107 | 52 | 5,579 63 | 116 00 | 733 | 42 | 775 | 12 |
| - | - | - | - | - | - | - | - | - | - | - |
| - | [6]- | 214 | 191 | 14 | 845 45 | - | - | - | - | 3 |
| 14 80 | 14 80 | 110 | - | 8 | 406 95 | - | 390 | 202 | 592 | 3 |
| 77 00 | 52 20 | 237 | 105 | 1 | 610 35 | - | 204 | 249 | 453 | 3 |
| 22 75 | 21 28 | 151 | - | 16 | 995 25 | - | 315 | 281 | 596 | 3 |
| 62 00 | 62 00 | 350 | 4 | 24 | 3,061 50 | - | 1,031 | 633 | 1,664 | 3 |
| 28 00 | 21 00 | 177 | 25 | 18 | 1,493 16 | 90 00 | 463 | 378 | 841 | 3 |
| 22 00 | 19 37 | 202 | 71 | 23 | 1,151 01 | 3 37 | 500 | 586 | 1,086 | 3 |
| 14 75 | 12 75 | [2]185 | - | 17 | 463 30 | 25 | - | - | [4]350 | 3 |
| 843 00 | 843 00 | [2]384 | - | 89 | 6,317 02 | 1,844 30 | 1,809 | 53 | 1,862 | 3 |
| 112 00 | 55 00 | [2]126 | - | 14 | 778 88 | - | 370 | 149 | 519 | 3 |
| 119 25 | 94 25 | - | - | 17 | 1,716 30 | - | 714 | 52 | 766 | 3 |
| 53 00 | 53 00 | 154 | - | 25 | 1,369 62 | 263 50 | 575 | 283 | 858 | 3 |
| 34 50 | 34 50 | 165 | 52 | 29 | 1,715 75 | 235 00 | 816 | 911 | 1,727 | 3 |
| - | - | 153 | 41 | 23 | 1,176 20 | 75 | 515 | 44 | 559 | 3 |
| $2,546 65 | $2,312 96 | 7,742 | 1,686 | 706 | $45,447 81 | $4,088 62 | 21,879 | 6,599 | 30,033 | 129 |

[1] Names on book. [2] And gratuities. [3] In the county.
[4] Estimated. [5] Excepting window gardeners. [6] Diplomas.

# STATE BOARD OF AGRICULTURE.

## Members ex Officio.

HIS EXCELLENCY WM. E. RUSSELL.
HIS HONOR WM. H. HAILE.
HON. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., *President Massachusetts Agricultural College.*

## Members Appointed by the Governor and Council.

| | Term Expires. |
|---|---|
| JAMES W. STOCKWELL of Sutton, | 1892 |
| JAMES S. GRINNELL of Greenfield, | 1893 |
| ELBRIDGE CUSHMAN of Lakeville, | 1894 |

## Members Chosen by the Incorporated Societies.

| | | |
|---|---|---|
| *Amesbury and Salisbury (Agr'l and Hort'l),* | F. W. SARGENT of Amesbury, | 1894 |
| *Attleborough (Agr'l Assoc'n),* | ISAAC ALGER of Attleborough, | 1894 |
| *Barnstable County,* | NATHAN EDSON of Barnstable, | 1892 |
| *Bay State,* | F. H. APPLETON of Peabody (P. O. Lynnfield), | 1893 |
| *Berkshire,* | CHAS. A. MILLS of South Williamstown, | 1894 |
| *Blackstone Valley,* | HENRY A. COOK of Northbridge (P. O. Whitinsville), | 1894 |
| *Bristol County,* | N. W. SHAW of North Raynham, | 1893 |
| *Deerfield Valley,* | J. D. AVERY of Buckland, | 1893 |
| *Eastern Hampden,* | WM. HOLBROOK, M.D., of Palmer, | 1894 |
| *Essex,* | BENJAMIN P. WARE of Marblehead (P. O. Clifton), | 1893 |
| *Franklin County,* | J. C. NEWHALL of Conway, | 1892 |
| *Hampden,* | C. F. FOWLER of Westfield, | 1894 |
| *Hampshire,* | D. A. HORTON of Northampton, | 1892 |
| *Hampshire, Franklin and Hampden,* | E. C. CLAPP of Northampton, | 1894 |
| *Highland,* | HIRAM TAYLOR of Middlefield, | 1893 |
| *Hillside,* | WM. BANCROFT of Chesterfield, | 1893 |
| *Hingham (Agr'l and Hort'l),* | EDMUND HERSEY of Hingham, | 1894 |
| *Hoosac Valley,* | A. J. BUCKLIN of Adams, | 1894 |
| *Housatonic,* | J. H. ROWLEY of Egremont Plain, | 1894 |
| *Marshfield (Agr'l and Hort'l),* | L. S. RICHARDS of Marshfield Hills, | 1894 |
| *Martha's Vineyard,* | N. S. SHALER of Cambridge, | 1892 |
| *Massachusetts,* | E. F. BOWDITCH of Framingham, | 1894 |
| *Massachusetts Horticultural,* | E. W. WOOD of West Newton, | 1894 |
| *Middlesex,* | W. W. RAWSON of Arlington, | 1894 |
| *Middlesex North,* | A. C. VARNUM of Lowell, | 1892 |
| *Middlesex South,* | S. B. BIRD of Framingham, | 1893 |
| *Nantucket,* | GEO. H. GARDNER of Nantucket, | 1894 |
| *Oxford,* | D. M. HOWE of Charlton (P. O. Oxford), | 1892 |
| *Plymouth County,* | AUGUSTUS PRATT of No. Middleborough, | 1893 |
| *Spencer (Far's and Mech's Assoc'n),* | J. G. AVERY of Spencer, | 1892 |
| *Union,* | C. B. HAYDEN of Blandford, | 1892 |
| *Weymouth (Agr'l and Ind'l),* | Q. L. REED of South Weymouth, | 1894 |
| *Worcester,* | C. L. HARTSHORN of Worcester, | 1893 |
| *Worcester East,* | W. A. KILBOURN of South Lancaster, | 1894 |
| *Worcester North,* | GEORGE CRUICKSHANKS of Fitchburg, | 1893 |
| *Worcester North-west,* | WM. H. BOWKER of Boston, | 1892 |
| *Worcester South,* | G. L. CLEMENCE of Southbridge, | 1892 |
| *Worcester County West,* | P. M. HARWOOD of Barre, | 1893 |

Secretary of the Board, WILLIAM R. SESSIONS of Hampden.
Chemist to the Board, C. A. GOESSMANN, Ph.D., LL.D., of Amherst.
Entomologist to the Board, C. H. FERNALD, Ph.D., of Amherst.
Office of the Secretary, Commonwealth Building, Boston.

# MASSACHUSETTS AGRICULTURAL COLLEGE.

*Location, Amherst, Hampshire County.*

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# MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

*Location, Amherst, Hampshire County.*

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## BOARD OF CONTROL.

His Excellency WM. E. RUSSELL, Governor of the Commonwealth, *President ex officio.*

| | Term Expires. |
|---|---|
| D. A. HORTON of Northampton, . . . . . . . . . | 1892. |
| CALVIN L. HARTSHORN of Worcester, . . . . . . . | 1894. |
| *Elected by the State Board of Agriculture.* | |
| THOMAS P. ROOT of Barre, . . . . . . . . . . | 1891. |
| J. HOWE DEMOND of Northampton, . . . . . . . . | 1893. |
| *Elected by the Board of Trustees of the Massachusetts Agricultural College.* | |
| FRANCIS H. APPLETON of Peabody, . . . . . . . . | 1892. |
| *Elected by the Massachusetts Society for Promoting Agriculture.* | |
| ELBRIDGE CUSHMAN of Lakeville, . . . . . . . . . | 1892. |
| *Elected by the Massachusetts State Grange.* | |
| WILLIAM C. STRONG of Newton (P. O. Waban), . . . . . | 1894. |
| *Elected by the Massachusetts Horticultural Society.* | |

HENRY H. GOODELL, M.A., of Amherst, *President of the Massachusetts Agricultural College.*

CHARLES A. GOESSMANN, Ph.D., LL.D., of Amherst, *Director of the Station.*

WILLIAM R. SESSIONS of Hampden, *Secretary of the State Board of Agriculture.*

## OFFICERS ELECTED BY THE BOARD OF CONTROL.

| | |
|---|---|
| HENRY H. GOODELL, M.A., of Amherst, . . . | *Vice-President.* |
| WILLIAM R. SESSIONS of Hampden, . . . . | *Secretary and Auditor.* |
| FRANK E. PAIGE of Amherst, . . . . . . . . . | *Treasurer.* |
| CHARLES A. GOESSMANN, Ph.D., LL.D., of Amherst, | *Director and Chemist.* |
| JAMES E. HUMPHREY, S.B., of Amherst, . . | *Vegetable Physiologist.* |

## BOARD OF CATTLE COMMISSIONERS.

| | Term Expires. |
|---|---|
| LEVI STOCKBRIDGE of Amherst, *Chairman*, . . . . . . | 1891. |
| ALONZO W. CHEEVER of Dedham, *Secretary*, . . . . . | 1893. |
| OBADIAH B. HADWEN, of Worcester, . . . . . . . | 1892. |

## AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE.

| NAME. | PRESIDENT. | SECRETARY. | TREASURER. |
|---|---|---|---|
| Amesbury and Salisbury,* | F. W. Sargent, Amesbury. | A. H. Fielden, Amesbury. | W. H. Dewhurst, Amesbury. |
| Attleborough (Ag'l Asso.) | J. G. Barden, Plainville. | L. F. Mendell, Plainville. | Wm. H. Wade, Plainville. |
| Barnstable County, | John Simpkins, Yarmouth. | F. C. Swift, Yarmouthport. | A. F. Edson, Barnstable. |
| Bay State, | H. S. Russell, Milton. | F. H. Appleton, Lynnfield. | Wm. H. Bowker, Boston. |
| Berkshire, | Geo. Z. Dean, Cheshire. | R. H. Cooke, Pittsfield. | J. P. Merrill, Pittsfield. |
| Blackstone Valley, | C. C. Capron, Uxbridge. | William L. Johnson, Uxbridge. | Jas. M. Farnum, Uxbridge. |
| Bristol County, | Frank L. Fish, Taunton. | D. L. Mitchell, Taunton. | J. R. Tallman, Taunton. |
| Deerfield Valley, | C. B. Newell, Rowe. | M. M. Mantor, Charlemont. | J. A. Wells, Charlemont. |
| Eastern Hampden, | W. M. Tucker, Monson. | O. P. Allen, Palmer. | O. P. Allen, Palmer. |
| Essex, | B. P. Ware, Clifton. | J. M. Danforth, Lynnfield Centre. | G. L. Streeter, Salem. |
| Franklin County, | C. W. Leighton, Greenfield. | F. L. Greene, Greenfield. | F. L. Greene, Greenfield. |
| Hampden, | F. E. Clark, Wilbraham. | Ethan Brooks, West Springfield. | E. S. Batchelder, Springfield. |
| Hampshire, | D. J. Wright, Northampton. | H. C. Nash, Jr., Amherst. | H. C. Nash, Jr., Amherst. |
| Hampshire, Franklin and Hampden, | C. B. Lyman, Southampton. | S. S. Warner, Northampton. | D. J. Wright, Northampton. |
| Highland, | H. A. Barton, Jr., Dalton. | J. McElwain, Middlefield. | M. J. Smith, Middlefield. |
| Hillside, | Alvan Barrus, Goshen. | Wm. G. Atkins, West Cummington. | R. R. Packard, Cummington. |
| Hingham,* | E. L. Ripley, Hingham. | Wm. H. Thomas, Hingham. | Reuben Sprague, Hingham. |
| Hoosac Valley, | F. E. Swift, North Adams. | G. F. Miller, North Adams. | S. B. Dibble, North Adams. |
| Housatonic, | Alonzo Bradley, Lee. | H. T. Robbins, Great Barrington. | W. B. Sanford, Great Barrington. |
| Marshfield,* | G. W. Emery, Marshfield. | Francis Collamore, Pembroke. | Francis Collamore, Pembroke. |
| Martha's Vineyard, | H. G. Norton, Vineyard Haven. | B. T. Hillman, Chilmark. | D. W. Mayhew, West Tisbury. |
| Massachusetts, | Thomas Motley, Jamaica Plain. | E. F. Bowditch, Framingham. | J. C. Rogers, Boston. |
| Middlesex, | W. W. Rawson, Arlington. | Wm. H. Hunt, Concord. | D. G. Lang, Concord. |
| Middlesex North, | A. C. Varnum, Lowell. | E. T. Rowell, Lowell. | S. Drewett, Lowell. |
| Middlesex South, | Isaac Damon, Wayland. | S. B. Bird, Framingham. | C. J. Frost, Framingham. |

* And horticultural.

## AGRICULTURAL SOCIETIES INCORPORATED BY SPECIAL ACT OF LEGISLATURE, AND REPRESENTED ON THE BOARD OF AGRICULTURE. — *Concluded.*

| NAME. | PRESIDENT. | SECRETARY. | TREASURER. |
|---|---|---|---|
| Nantucket, | Albert Easton, Nantucket. | J. F. Murphey, Nantucket. | Asa C. Jones, Nantucket. |
| Oxford, | A. L. Joslin, Oxford. | W. H. H. Thurston, Oxford. | W. H. H. Thurston, Oxford. |
| Plymouth County, | J. C. Swan, West Bridgewater. | G. W. R. Hill, Brockton. | Geo. M. Hooper, Bridgewater. |
| Spencer, | C. N. Prouty, Spencer. | T. J. Comins, Spencer. | I. L. Prouty, Spencer. |
| Union, | C. M. Blair, Blandford. | E. W. Boise, Blandford. | W. J. Peebles, Blandford. |
| Weymouth (Ag'l and Ind.) | B. F. Poole, Rockland. | H. W. Dyer, South Weymouth. | Gordon Willis, South Weymouth. |
| Worcester, | J. L. Ellsworth, Worcester. | F. H. Chamberlain, Worcester. | F. H. Chamberlain, Worcester. |
| Worcester East, | J. E. Thayer, Lancaster. | W. A. Kilbourn, South Lancaster. | Lucius Field, Clinton. |
| Worcester North, | Geo. Cruickshanks, Fitchburg. | S. W. Huntley, Fitchburg. | A. F. Whitney, Fitchburg. |
| Worcester North-west, | J. W. Wheeler, Orange. | F. G. Amsden, Athol Centre. | T. H. Goodspeed, Athol Centre. |
| Worcester South, | Geo. W. Wells, Southbridge. | C. V. Corey, Sturbridge. | C. V. Corey, Sturbridge. |
| Worcester County West, | Wm. A. Warner, Hardwick. | Matthew Walker, Barre. | Chas. H. Follansby, Barre. |

## HORTICULTURAL SOCIETIES.

| NAME. | LOCATION. | PRESIDENT. | SECRETARY. |
|---|---|---|---|
| Hampden County, | Springfield, | J. E. Taylor, Springfield. | B. L. Bragg, Springfield. |
| Houghton, | Lynn, | J. W. Goodell, M.D., Lynn. | Frank W. Mace, Lynn. |
| Hyde Park, | Hyde Park, | W. C. Eustis, Hyde Park. | Geo. E. Haven, Hyde Park. |
| Massachusetts,* | Boston, | Wm H. Spooner, Jamaica Plain. | Robert Manning, Boston. |
| Newton, | Newton, | D. D. Slade, Newton. | L. H. Farlow, Newton. |
| Springfield Amateur, | Springfield, | C. L. Simons, Springfield. | G. H. Lapham, Springfield. |
| Wakefield,† | Wakefield, | W. F. Young, Wakefield. | Mrs. J. F. Woodward, Wakefield. |
| Worcester County, | Worcester, | H. L. Parker, Worcester. | E. W. Lincoln, Worcester. |

* Incorporated and represented on the Board of Agriculture.

† And agricultural.

### Farmers' and Mechanics' Associations.

| | | | |
|---|---|---|---|
| Princeton, | Princeton, | J. C. F. Mirick, Princeton. | J. E. Merriam, Princeton. |
| Oakham, | Oakham, | H. P. Austin, Oakham. | W. M. Robinson, Oakham. |
| Needham, | Needham, | James Mackintosh, Needham. | A. K. Tisdale, Dover. |
| Leominster, | Leominster, | A. L. Whitney, Leominster. | C. H. Rice, Leominster. |
| Bolton, | Bolton, | H. F. Haynes, Bolton. | W. M. Brigham, Bolton. |
| Middlesex and Worcester, | Hudson, | R. H. Hapgood, Hudson. | J. S. Welsh, Hudson. |

### Farmers' and Mechanics' Clubs.

| | | | |
|---|---|---|---|
| Holden, | Holden, | E. J. Miles, Jeffersonville. | E. Truesdell, Holden. |
| West Acton, | West Acton, | Isaac Reed, West Acton. | C. B. Stone, West Acton. |
| Ashby, | Ashby, | H S. Brooks, Ashby. | E. A. Hubbard, Ashby. |
| Berlin, | Berlin, | P. B Southwick, Berlin. | F. H. Crossman, Berlin. |
| Groton, | Groton, | Daniel Needham, Groton. | Charles Woolley, Groton. |
| Wilmington, | Wilmington, | John T. Wild, Wilmington. | E. M. Nichols, Wilmington. |
| Belchertown, | Belchertown, | D. F. Shumway, Belchertown. | G. H. B. Green, Belchertown. |
| Shrewsbury, | Shrewsbury, | G. H. Harlow, Shrewsbury. | Frank J. Stone, Shrewsbury. |
| Shirley, | Shirley, | E. G. Adams, Shirley. | G. C. Boutwell, Shirley. |

### Farmers' Clubs.

| | | | |
|---|---|---|---|
| Lunenburg, | Lunenburg, | J. H. Witherell, Lunenburg. | James Hildreth, 2d, Lunenburg. |
| Southborough, | Southborough, | Rev. D. E. Adams, Southborough. | D. W. C. McMasters, Southborough. |
| Tatnuck, | Worcester, | W. W. Clapp, Worcester. | W. N. Wright, Worcester. |
| Chamberlain District, | Worcester, | B. W. Potter, Worcester. | S. A. Burgess, Worcester. |
| Lancaster, | Lancaster, | Nicholas Frost, Lancaster. | F. A. Hanaford, Lancaster. |

FARMERS' CLUBS — *Concluded.*

| NAME. | LOCATION. | PRESIDENT. | SECRETARY. |
|---|---|---|---|
| Wilbraham, | Wilbraham, | James Richard, Wilbraham. | H. M. Bliss, Wilbraham. |
| Sutton, | Sutton, | O. P. Johnson, Sutton. | A. W. Putnam, Sutton. |
| Dartmouth, | North Dartmouth, | L. T. Davis, North Dartmouth. | A. J. Potter, North Dartmouth. |
| Royalston, | Royalston, | A. D. Raymond, Royalston. | G. E. Peirce, Royalston. |
| Ashfield, | Ashfield, | F. H. Smith, Ashfield. | A. G. Howes, Ashfield. |
| Halifax, | Halifax, | Otis Pratt, Halifax. | Mrs. J S. Pope, Halifax. |
| East Charlemont, | East Charlemont, | O. Maxwell, East Charlemont. | Rev. Dr. Lyman Whiting, E. Charlemont. |
| North Raynham, | North Raynham, | E. B. Hale, North Raynham. | N. W. Shaw, North Raynham. |
| Rutland, | Rutland, | L. Q. Spaulding, Rutland. | A. L. Miles, Rutland. |
| New Salem, | New Salem, | W. J. Whitaker, New Salem. | Daniel Ballard, Millington. |
| South Bristol, | New Bedford, | Franklyn Howland, Acushnet. | Geo A. Potter, New Bedford. |
| West Brookfield, | West Brookfield, | W. E. Patrick, Warren. | L. H. Chamberlain, West Brookfield. |
| Rehoboth, | Rehoboth, | H. T. Horton, Rehoboth. | Ellery L. Goff, Rehoboth. |
| Buckland, | Buckland, | Geo. A. Ham, Buckland. | Mrs. M. A. Forbes, Buckland. |
| Marblehead and Swampscott, | Beach Bluff, | Wm. Miller, Swampscott. | Bella Miller, Swampscott. |
| Easthampton, | Easthampton, | L. E. Parsons, Easthampton. | C. T. Burt, Easthampton. |
| Upton, | Upton, | B. A. Jourdan, Upton. | J. S. Le Sure, Upton. |
| West Peabody, | West Peabody, | G. H. Legro, West Peabody. | Mrs. E. A. Needham, West Peabody. |
| Boxborough, | Boxborough, | C. T. Wetherbee, Littleton. | A. W. Wetherbee, West Acton. |
| Practical, | Egremont, | H. T. Cande, Sheffield. | Mrs. T. S. Baldwin, North Egremont. |
| Franklin, | Franklin, | James Hood, Franklin. | C. M. Allen, Franklin. |
| New Braintree, | New Braintree, | J. E. Barr, New Braintree. | Horatio Moore, New Braintree. |
| Huntington, | Norwich, | C. H. Strong, Norwich. | H. W. Stickney, Norwich. |
| West Bridgewater, | West Bridgewater, | F. E. Howard, West Bridgewater. | Mrs. H. J. Le Lacheur, W. Bridgewater. |
| Sterling, | Sterling, | Geo. M. Stuart, Sterling. | H. P. Kendall, Sterling. |
| South Deerfield, | South Deerfield, | E. W. Jackson, South Deerfield. | W. W. Sanderson, South Deerfield. |
| North Westport, | North Westport, | E. L. Gifford, North Westport. | A. S. Sherman, North Westport. |
| Rowley, | Rowley, | J. D. Dodge, Rowley. | T. P. Hale, Rowley. |
| West Newbury, | West Newbury, | Samuel Rogers, West Newbury. | J. N. Lane, West Newbury. |
| Waltham, | Waltham, | M. R. Leonard, Waltham. | A. Starbuck, Waltham. |
| Burlington, | Burlington, | T. I. Reed, Burlington. | A. S. Wood, Burlington. |

## MISCELLANEOUS.

| | | | |
|---|---|---|---|
| Hampden Harvest Club, | Connecticut Valley, | The Members Alternately. | J. N. Bagg, West Springfield. |
| Franklin Harvest Club, | Connecticut Valley, | W. H. Wilkinson, Holyoke. | C. B. Lyman, Southampton. |
| Young Men's Harvest Club, | Ludlow, | C. B. Bennett, Ludlow. | E. N. Fisher, Ludlow. |
| Agricultural Library Association, | Swansea, | N. B. Gardner, Swansea Centre. | A. E. Arnold, Swansea Centre. |
| Farmers' and Gardeners' Club, | Hanson, | John Barker, Hanson. | F. S. Thomas, M.D., Hanson. |
| Boston Market Gardeners' Association, | Boston and vicinity, | W. W. Rawson, Arlington. | G. H. Cutter, Arlington. |
| Cranberry Growers' Association, | Cape Cod District, | J. J. Russell, Plymouth. | I. T. Jones, Sandwich. |
| Bristol Co. Fruit Growers' Association, | Dighton, | Wm. P. Hood, Somerset. | W. P. Eddy, Dighton. |
| Young People's Agricultural Club, | Wilbraham, | Lee W. Rice, Wilbraham. | Walter M. Bliss, Wilbraham. |
| Brockton,* | Brockton, | H. W. Robinson, Brockton. | Ira Copeland, Brockton. |
| Westborough,* | Westborough, | N. P. Brown, Westborough. | S. W. Rice, Westborough. |

* Incorporated under general law.

## POULTRY ASSOCIATIONS.

| | | | |
|---|---|---|---|
| Bay State, | Worcester, | C. A. Ballou, Worcester. | H. A. Jones, Worcester. |
| Brockton Poultry and Pet Stock, | Brockton, | J. W. Shaw, Brockton. | Wm. F. Bond, Brockton. |
| Eastern Middlesex, | Stoneham, | W. S. Keene, Stoneham. | G. W. Cromack, Stoneham. |
| Massachusetts, | Boston, | W. B. Atherton, Newton Lower Falls. | R. S. Mackintosh, Jr., Boston. |
| Northern Middlesex Poultry and Pet Stock, | Clinton, | – | A. A. Fillebrown, Ayer. |
| Old Colony, | Quincy, | Preston Pratt, South Weymouth. | J. E. Gardner, South Weymouth. |
| The Gt. Barrington Poultry, Pigeon and Pet Stock, | Great Barrington, | Samuel Camp, M.D., Great Barrington. | F. D. Rowe, Great Barrington. |
| Waltham Fanciers' Club, | Waltham, | William E. Bright, Waltham. | F. H. Gordon, Waltham. |
| Western Massachusetts, | Springfield, | William Provin, Westfield. | S. W. Craig, Springfield. |
| Woburn Fanciers' Club, | Woburn, | – | M. W. True, Woburn. |

# MASSACHUSETTS PATRONS OF HUSBANDRY.

### Officers of the State Grange, 1891.

| | |
|---|---|
| Master, | N. B. Douglas of Sherborn. |
| Overseer, | P. M. Harwood of Barre. |
| Lecturer, | George C. Howard of Cochesett. |
| Steward, | E. A. Emerson of Haverhill. |
| Assistant Steward, | G. N. Brown of Dalton. |
| Chaplain, | Rev. C. S. Walker of Amherst. |
| Treasurer, | F. A. Harrington of Worcester. |
| Secretary, | George R. Chase of Medfield. |
| Gate Keeper, | Lyman M. Rice of Grafton. |
| Ceres, | Mrs. Carrie B. Sage of West Springfield. |
| Pomona, | Mrs. Harriet M. Judd of South Hadley. |
| Flora, | Mrs. Minnie M. Chase of Medfield. |
| Lady Assistant Steward, | Mrs. F. L. Chamberlain of Holden. |

### Executive Committee.

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|---|---|
| C. A. Dennen of Pepperell, | One year. |
| S. E. Stowe of Grafton, | Two years. |
| H. A. Barton, Jr., of Dalton, | Three years. |

### Deputies.

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|---|---|
| S. B. Cook, | Petersham. |
| A. A. Metcalf, | Holden. |
| George R. Chase, | Medfield. |
| A C. Stoddard, | North Brookfield. |
| D. A. Horton, | Northampton. |
| S. V. Crane, | Blackstone. |
| John H. Smith, | Dalton. |
| Mrs. F. A. Harrington, | Worcester. |
| George C. Howard, | Cochesett. |
| I. C. Day, | South Groveland. |
| George A. Hastings, | West Berlin. |
| Warren C. Jewett, | Worcester. |
| Mrs. Alice M. Davis, | Shrewsbury. |
| N. T. Smith, | West Springfield. |
| James Hildreth, 2d, | Lunenburg. |
| John W. Gifford, | South Westport. |
| B. W. Hero, | Westborough. |
| J. L. Smith, | Barre. |

## MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---|---|---|---|
| *District Granges.* | | | |
| Berkshire County, | Peter Parsons, Hinsdale. | Mrs. Lucy A. Aldrich, Dalton. | Mrs. A. H. Torrey, Williamstown. |
| Worcester West Distrit, | E. A. Albee, North Dana. | J. L. Smith, Barre. | Mrs. Mattie R. Knapp, North Dana. |
| Worcester Central County, | Geo. L. Davis, Shrewsbury. | Adin A. Hixon, Worcester. | Mrs. R. M. Rice, Shrewsbury. |
| Borough District, | Samuel Wheeler, Berlin. | Mrs. G. B. Wood, Northborough. | Mrs. A. Keyes, Berlin. |
| Middlesex and Norfolk Union, | Geo. R. Chase, Medfield. | Rev. Daniel Round, Norfolk. | Miss Belle R. Hayward, Fayville. |
| Connecticut Valley District, | C. A. Judd, South Hadley Falls. | H. C. West, Belchertown. | Miss Sarah Mason, Northampton. |
| Middlesex and Worcester Union, | F. M. Boutwell, Groton. | James Hildreth, 2d, Lunenburg. | E. A. Emerson, Haverhill. |
| Worcester Southwest District, | A. C. Stoddard, North Brookfield. | Noah Ladd, Sturbridge. | A. M. Dodge, Charlton. |
| Franklin and Worcester Union, | A. N. Harrington, North Orange. | L. B. Caswell, Athol. | Mrs. F. J. Butterworth, Athol. |
| Lancaster District, | W. A. Kilbourn, South Lancaster. | Mrs. E. A. Currier, Clinton. | Mrs. E. Cunningham, Lancaster. |
| Springfield District, | F. A. Forward, Granby. | Arthur Sikes, Suffield, Ct. | Mrs. W. L. Phelps, Wilbraham. |
| Old Colony District, | Joseph Gibbs, Somerset. | Amos H. Eaton, Middleborough. | Miss A. C. Tinkham, Middleborough. |
| Essex County, | I. C. Day, South Groveland. | S. K. Fowler, Amesbury. | F. S. Webster, Haverhill. |
| *Subordinate Granges.* | | | |
| Groton, No. 7, | G. L. Smith, East Pepperell. | Daniel Needham, Groton. | Mrs. E. P. Woolley, Groton. |
| Barre, No. 9, | C. N. Winship, Barre. | F. A. Pitcher, Barre. | Mrs. H. N. Patterson, Barre. |
| Amherst, No. 16, | C. E. Wakefield, Amherst. | Thomas W. Smith, Amherst. | Emily R. Cook, Amherst. |
| Hinsdale, No. 19, | Thos. F. Barker, Hinsdale. | Mrs. F. F. Watkins, Hinsdale. | John S. Cole, Hinsdale. |
| Lanesborough, No. 21, | S. L. Miner, Lanesborough. | P. P. Gardner, Lanesborough. | Chas. H. Deming, Lanesborough. |
| Worcester, No. 22, | W. C. Jewett, Worcester. | J. E. Goodell, West Boylston. | Miss Ellen M. Flagg, Worcester. |
| Dalton, No. 23, | W. B. Barton, Dalton. | Mrs. E. D. Aldrich, Dalton. | M. Agnes Young, Dalton. |
| "Resolute" of Hatfield, No. 25, | Thaddeus Graves, Hatfield. | S. L. Cutler, Hatfield. | A. H. Graves, Hatfield. |
| Richmond, No. 32, | M. W. Coleman, West Pittsfield. | Mrs. M. W. Coleman, West Pittsfield. | Elizabeth P. Nichols, Richmond. |
| Sterling, No. 53, | G. M. Stuart, Sterling. | Mrs. J. S. Burpee, Sterling. | M. L. Coolidge, West Sterling. |
| Auburn, No. 60, | Luther N. Stone, Auburn. | Mrs. J. J. Allen, West Millbury. | Grace A. Rice, Auburn. |
| "Union" of Belchertown, No. 64, | W. H. Bridgman, Belchertown. | H. C. West, Belchertown. | J. W. Jackson, Belchertown. |
| Hardwick, No. 67, | J. H. Hillman, Hardwick. | Mrs. Chas. Clark, Hardwick. | Susie B. Manly, Hardwick. |
| Phillipston, No. 70, | Wilson Smith, Phillipston. | J. W. Moore, Phillipston. | Miss M. B. Hager, Phillipston. |
| "Prescott" of Pepperell, No. 73, | H. C. Grey, Pepperell. | A. N. Blood, Pepperell. | Emma J. Dennen, Pepperell. |

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---|---|---|---|
| *Subordinate Granges* — Con. | | | |
| Holden, No. 78, | C. T. Mead, Holden. | Chas. Phillips, Holden. | Mrs. S. N. Hubbard, Holden. |
| Spencer, No. 79, | H. H. Kingsbury, Spencer. | J. W. Bigelow, Spencer. | Edson C. Bemis, Spencer. |
| "Manhan" of Southampton, No. 82, | J. S. Frary, Southampton. | H. O. Strong, Southampton. | Miss Florence Hannum, Southampton. |
| North Orange, No. 86, | A. N. Harrington, North Orange. | M. D. Herrick, North Orange. | Mrs. Flora J. Butterworth, Athol. |
| Lee, No. 88, | C. G. Hinckley, Lee. | Mrs. C. H. Shaylor, Lee. | E. F. Ingersoll, Lee. |
| Charlton, No. 92, | A. M. Dodge, Charlton. | H. M. Dodge, Charlton. | Albert R. Jones, Charlton. |
| Grafton, No. 93, | Perley Goddard, Grafton. | Mrs. E. M. W. Fiske, Grafton. | Miss Emma J. Knight, North Grafton. |
| Petersham, No. 95, | D. F. Bigelow, Petersham. | Mrs. Martha A. Webb, Nichewaug. | Mrs. R. J. Stone, Petersham. |
| Shrewsbury, No. 101, | H. W. Loring, Shrewsbury. | Lottie M. Howe, Shrewsbury. | J. A. Gleason, Shrewsbury. |
| Stow, No. 103, | F. H. Stevens, West Acton. | A. J. Smith, Stow. | Mrs. U. M. Lewis, Stow. |
| "Garfield" of North Dana, No. 104, | E. A. Albee, North Dana. | M. T. Knapp, North Dana. | Mrs. M. T. Knapp, North Dana. |
| Marlborough, No. 105, | C. S. Howe, Marlborough. | J. H. Dyer, Marlborough. | Abbie A. Brigham, Marlborough. |
| West Boylston, No. 106, | J. F. Knight, West Boylston. | Mrs. A. D. Lord, West Boylston. | Miss Mary Johnson, West Boylston. |
| Millbury, No. 107, | J. W. Pierce, West Millbury. | Mrs. J. C. Hayward, Millbury. | I. E. Howe, Millbury. |
| Hudson, No. 108, | F. P. Glazier, Hudson. | Mrs. Susie J. Hale, Hudson. | Mrs. F. Emma Wood, Hudson. |
| Sutton, No. 109, | C. C. Hall, Millbury. | Miss Leila S. Taylor, Sutton. | Mrs. Sarah M. Mills, Sutton. |
| Sherborn, No. 110, | F. T. Daniels, Sherborn. | G. L. Whitney, South Framingham. | Miss Maud Hayward, Sherborn. |
| Boylston, No. 111, | G. A. Hastings, Boylston Centre. | Calvin Hastings, Boylston Centre. | Daisy E. Flagg, Boylston Centre. |
| "East Medway" of Millis, No. 112, | E. F. Richardson, Millis. | E. F. Lovell, Millis. | Geneive F. Howe, Millis. |
| Framingham, No. 113, | Geo. Fay, Framingham. | Harry Walkup, Framingham. | Mrs. Emma Rooke, Fayville. |
| Medfield, No. 114, | William F. Weiker, Medfield. | J. M. Alexander, Medfield. | Mrs. E. C. Woodward, Medfield. |
| Holliston, No. 115, | J. B. Parkin, Holliston. | Mrs. J. C. Champney, Holliston. | Miss M. E. Cutler, Holliston. |
| Westborough, No. 116, | B. W. Hero, Westborough. | Mrs. Mary E. Graham, Westborough. | Miss Jennie Graham, Westborough. |
| Dover, No. 117, | Herbert Hale, Dover. | S. Eudora Shumway, Dover. | Margaret McGill, Dover. |
| Southborough, No. 118, | E. F. Collins, Southborough. | Mrs. D. B. Harvie, Southborough. | Mary C. Collins, Southborough. |
| Northborough, No. 119, | W. F. Hayes, Northborough. | Mrs. C. J. Mack, Northborough. | Mrs. G. B. Wood, Northborough. |
| Lancaster, No. 120, | F. A. Hanaford, South Lancaster. | Calvin Maynard, Lancaster. | Mrs. Annie M. L. Clark, Lancaster. |
| Sudbury, No. 121, | Chas. E. Haynes, Jr., Sudbury. | Miss Hattie Goodnow, Sudbury. | Emily F. Willis, Sudbury. |
| Templeton, No. 122, | L. W. Bryant, Templeton. | Lucien Gove, East Templeton. | Mrs. Mary A. Gove, East Templeton. |
| Oxford, No. 123, | Herbert Lovell, Oxford. | C. Putnam, Oxford. | Miss A. S. Brady, Oxford. |
| Ashland, No. 124, | C. E. Adams, South Framingham. | Mrs. C. E. Adams, Ashland. | Henry Burnham, Ashland. |

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| Upton, No. 125, | W. F. Wheeler, Woodville. | Chas. S. Temple, Upton. | L. Jenny Chapman, West Upton. |
| Hubbardston, No. 126, | O. E. E. Tyler, Hubbardston. | Darius Parsons, Hubbardston. | Eva S. Mason, Hubbardston. |
| Amesbury, No. 127, | F. W. Sargent, Amesbury. | Lizzie I. Huntington, Amesbury. | Lucie A. Brierley, Amesbury. |
| North Andover, No. 128, | G. L. Averill, North Andover. | Geo. B. Chadwick, North Andover. | E. A. Fuller, North Andover. |
| Lincoln, No. 129, | I. C. Foster, Lincoln. | George Ropes, Lincoln. | Helen Weston, Lincoln. |
| Gardner, No. 130, | A. F. Johnson, West Gardner. | Geo. W. Goddard, West Gardner. | C. B. Boyce, Gardner. |
| Boxborough, No. 131, | Arthur Whitcomb, West Acton. | Albert Littlefield, West Acton. | Miss N. S. Loring, West Acton. |
| North Brookfield, No. 132, | John P. Ranger, North Brookfield. | Geo. P. Buck, North Brookfield. | H. L. Rand, North Brookfield. |
| West Dedham, No. 133, | Chas. H. Ellis, West Dedham. | W. W. Baker, West Dedham. | H. Elizabeth Fisher, West Dedham. |
| Berlin, No. 134, | W. A. Cartwright, Berlin. | Mrs. L. B. Wheeler, Berlin. | Carrie P. Jones, Berlin. |
| Norfolk, No. 135, | G. B. Sims, Norfolk. | N. H. Fales, Wrentham. | Miss Mabel Drayton, Norfolk. |
| Ipswich, No. 136, | W. F. Kinsman, Ipswich. | Mrs. Alden Story, Ipswich. | Mrs. Linda H. Underhill, Ipswich. |
| East Blackstone, No. 137, | Adrian Scott, Blackstone. | Mrs. Adelaide Stearns, Blackstone. | Miss Eva Welch, Blackstone. |
| Northampton, No. 138, | C. E. Parsons, Northampton. | G. T. Fletcher, Northampton. | Mrs. Levi H. Bartlett, Northampton. |
| East Sandwich, No. 139, | J. F. Carleton, East Sandwich. | J. E. Holway, Spring Hill. | Mrs. Rosa S. Armstrong, E. Sandwich. |
| West Boxford, No. 140, | W. M. Cole, West Boxford. | Mrs. Ella J. Andrew, West Boxford. | Ruth M. Webster, West Boxford. |
| Montague, No. 141, | F. A. Rist, Montague. | W. H. Nims, Montague. | F. A. Dean, Montague. |
| Bolton, No. 142, | Walter Cole, Bolton. | Mrs. H. C. Babcock, Bolton. | Mrs. Mary Mentzer, Bolton. |
| Mendon, No. 143, | A. W. Gaskill, Mendon. | L. E. Taft, Mendon. | A. E. Southwick, Mendon. |
| Franklin, No. 144, | E. P. Chapman, Franklin. | Mrs. R. H. Davidson, Franklin. | S. C. Brown, Medway. |
| Douglas, No. 145, | Stilman Russell, East Douglas. | Mrs. Mary A. Richardson, Douglas. | T. M. Potter, East Douglas. |
| West Newbury, No. 146, | L. W. Bradley, West Newbury. | Mrs. H. L. Bailey, West Newbury. | Mrs. R. C. Gowen, West Newbury. |
| West Springfield, No. 147, | N. T. Smith, West Springfield. | Mrs. E. A. Waters, Holyoke. | E. T. Sikes, West Springfield. |
| Swansea, No. 148, | J. N. Hicks, Swansea Centre. | Abbie A. Williams, Swansea Village. | Wm. G. Luther, Hortonville. |
| Harvard, No. 149, | J. B. Harlow, Harvard. | Mrs. Hattie M. Stone, Still River. | W. E. Blanchard, Ayer. |
| Concord, No. 150, | E. L. Tuttle, Concord. | Mrs. E. F. Lawrence, Concord. | G. B. Clark, Concord. |
| Agawam, No. 151, | W. H. Porter, Agawam. | F. H. King, Agawam. | Miss Carrie S. Leonard, Agawam. |
| East Longmeadow, No. 152, | J. M. Burt, East Longmeadow. | Mrs. F. C. Davis, East Longmeadow. | E. M. Burt, East Longmeadow. |
| Wilbraham, No. 153, | C. P. Bolles, Wilbraham. | Mrs. W. L. Phelps, Wilbraham. | Mrs. F. C. Learned, Wilbraham. |
| Haverhill, No. 154, | R. A. Corliss, Haverhill. | Susie A. Eastman, Haverhill. | Chas. W. Emerson, Ayer's Village. |
| Methuen, No. 155, | A. P. Russell, Lawrence. | Vira L. Gove, Methuen. | Bessie M. Swan, Methuen. |
| W. Bridgewater, No. 156, | C. G. Manly, Brockton. | G. C. Howard, Cochesett. | Chas. R. Packard, West Bridgewater. |
| Granby, No. 157, | Geo. P. Eastman, Granby. | Mrs. S. B. Dickinson, Granby. | Maud I. Davis, Granby. |
| "Nemasket" of Middleborough, No. 158, | A. H. Eaton, Middleborough. | Elbridge Cushman, Lakeville. | John G. Paine, Middleborough. |
| "Green River" of Williamstown, No. 159, | S. J. Kellogg, S. Williamstown. | G. B. Waterman, South Williamstown. | Miss Jennie M. Stevens, Williamstown. |
| South Hadley, No. 160, | Eugene Lyman, South Hadley. | A. L. Wright, South Hadley Falls. | Levi B. Allen, South Hadley. |
| "Laurel" of West Newbury, No. 161, | S. O. Ordway, West Newbury. | Annie L. Rogers, Newburyport. | C. E. Rowell, West Newbury. |

## Massachusetts Patrons of Husbandry — *Concluded.*

| NAME. | MASTER. | LECTURER. | SECRETARY. |
|---|---|---|---|
| *Subordinate Granges* — Con'ded. | | | |
| Dartmouth, No. 162, | J. W. Howland, Dartmouth. | J. W. Gifford, South Westport. | Laura E. Brightman, Dartmouth. |
| Dudley, No. 163, | W. H. Prince, Webster. | M. W. Ide, Dudley. | J. J. Gilles, Dudley. |
| Ware, No. 164, | E. W. Barney, Ware. | R. J. Nelligan, Ware. | Mrs. E. W. Barney, Ware. |
| Hampden, No. 165, | Dr. G. T. Ballard, Hampden. | Mrs. A. F. Ballard, Hampden. | Mrs. A. J. Tuttle, Hampden. |
| Wellesley, No. 166, | Thomas Whipple, Wellesley. | John F. Mills, Wellesley. | C. M. Chesbro, Wellesley Hills. |
| Rowe, No. 167, | C. C. Wheaton, Zoar. | J. F. Brown, Rowe. | C. A. Brown, Rowe. |
| Somerset, No. 168, | C. B. Hathaway, Pottersville. | Mrs. R. G. Buffington, Fall River. | Susie M. Hathaway, Pottersville. |
| Lunenburg, No. 169, | John Wooldredge, Lunenburg. | Jas. L. Harrington, Lunenburg. | E. Stone, Lunenburg. |
| New Braintree, No. 170, | Geo. H. Thompson, New Braintree. | Mrs. Chas. Thompson, New Braintree. | Fred W. Barnes, North Brookfield. |
| Merrimac, No. 171, | J. S. Peaslee, Newton, N.H. | May A. Hoyt, Merrimac. | True Hoyt, Merrimac. |
| Ashby, No. 172, | D. H. Damon, Ashby. | Mrs. H. F. Piper, Ashby. | Geo. B. Simonds, Ashby. |
| Hopkinton, No. 173, | L. L. Woolson, Hayden Row. | Mrs. Lillia A. Ward, Woodville. | Emma E. Thompson, Woodville. |
| Brookfield, No. 174, | G. S. Ayer, Brookfield. | Annie G. Laflin, Brookfield. | Sarah C. Mitchell, Brookfield. |
| Athol, No. 175, | Horace Drury, 2d, Athol Centre. | L. B. Caswell, Athol. | Mrs. A. A. Hill, Athol Centre. |
| "Miller's River" of Orange, No. 176, | A. Butler Coolidge, Orange. | O. G. Hutchins, Orange. | Anna M. Wrisley, Orange. |
| Sturbridge, No. 177, | H. W. Nichols, Sturbridge. | G. S. Ladd, Sturbridge. | Ellen L. Moore, Sturbridge. |
| Monson, No. 178, | O. Pease, Monson. | C. C. Keep, Monson. | A. M. Beebe, Monson. |
| Ludlow, No. 179, | G. S. Atchinson, Ludlow Centre. | Rev. M. P. Dickey, Ludlow Centre. | Hattie M. Banister, Ludlow Centre. |
| West Brookfield, No. 180, | C. S. Johnson, West Brookfield. | Mary E. Fairbanks, West Brookfield. | J. A. Watson, West Brookfield. |
| Westport, No. 181, | Marcellus Boynton, Central Village. | Annie F. Jenney, Central Village. | Frances H. Handy, South Westport. |
| Southbridge, No. 182, | Geo. L. Clemence, Southbridge. | J. E. Clemence, Southbridge. | Wm. C. Cady, Southbridge. |
| Andover, No. 183, | S. H. Boutwell, Lowell. | J. T. Lovejoy, Ballardvale. | Miss Bertha A. Chandler, Andover. |
| Topsfield, No. 184, | Chas. V. Jackman, Topsfield. | C. J. Peabody, Topsfield. | Annie F. Ferguson, Topsfield. |
| North Attleborough, No. 185, | George F. Dana, North Attleboro'. | Cora E. Holmes, North Attleboro'. | Jennie Henshaw, North Attleboro'. |
| Fitchburg, No. 186, | Alonzo Eaton, Fitchburg | Geo. H. Hastings, Fitchburg. | Andrew Pratt, Fitchburg. |
| "Satuit" of Scituate, No. 187, | C. L. Damon, Scituate. | A. B Anderson, Scituate. | C. O. Ellms, Scituate. |
| Littleton, No. 188, | T. S. Marshall, Littleton. | C. A. Priest, Littleton. | C. F. Watts, Littleton. |

## Farmers' League of Massachusetts.

F. A. Putnam, Dudley, *President.* Geo. M. Whitaker, Boston, *Secretary.* J. C. Poor, North Andover, *Treasurer.*

# THE STATE BOARD OF AGRICULTURE.

*From Bulletin No. 5, Crop Report for September, 1890.*

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The State Board of Agriculture was established by an Act of the Legislature in 1852, and the first meeting was held at the Council Chamber, Boston, July 22 of the same year, being presided over by His Excellency George S. Boutwell.

The first movement on the part of Massachusetts in modern agricultural progress was the appointment of Henry Colman as State commissioner, in 1836, for the agricultural survey of the State; and he prepared three excellent volumes on the agriculture of Massachusetts, counties of Essex, Berkshire, Franklin and Middlesex, and one volume on wheat and silk. However, this work was regarded by the Legislature of so little importance that it was suspended in the year 1840.

In 1850 the Legislature created a board of commissioners to report at the next session upon the expediency of establishing agricultural schools or colleges. This commission consisted of Marshall P. Wilder, Edward Hitchcock, Samuel A. Eliot, Thomas E. Payson and Eli Warren, and their report was made to the Legislature at its session in 1851. In this report it was recommended that a State department of agriculture be established, to consist of one member from, and to be elected by, each of the incorporated agricultural societies receiving the bounty of the State.

The preliminary efforts for the establishment of the State Board of Agriculture emanated from a meeting of the trustees of the Norfolk Agricultural Society, held Jan. 28, 1851. It was there voted that "the president and secretaries be a committee to mature and adopt a plan for a convention of delegates from the various agricultural societies of the Commonwealth, to be holden at some convenient time and place,

the object of which shall be to concert measures for their mutual advantage, and for the promotion of the cause of agricultural education."

This convention assembled at the State House, in Boston, March 20, 1851. The attendance was large, and the session lasted for several days.

As a result, the joint committee on agriculture of the Legislature reported a bill for the creation of a board of agriculture; but the further consideration of the subject, after much debate, was referred to the next Legislature.

This being a new measure, its possible failure was apprehended, and it was deemed expedient to establish a Central Board of Agriculture, whose duties should be substantially those which were proposed for a State department; and at the above-mentioned convention this was done.

Its board of officers were Marshall P. Wilder, president; Henry W. Cushman and John W. Lincoln, vice-presidents; Allen W. Dodge, corresponding secretary; Edgar Whitaker, recording secretary; with three delegates from each incorporated society receiving the bounty of the Commonwealth.

At a meeting of this Board, Jan. 14, 1852, it was resolved to petition the Legislature in the following resolution: —

*Resolved*, That, inasmuch as agriculture is the chief occupation of her citizens, the Commonwealth, in the organization of its government should be provided with a department of agriculture, with offices commensurate with the importance of the duties to be discharged and the labors to be performed.

These various efforts finally culminated in the establishment of the present State Department of Agriculture, which succeeded the existing voluntary Central Board.

The act was passed in 1852, and, at a meeting of the newly created Board of Agriculture, Aug. 5, 1852, Rev. Dr. Edward Hitchcock, president of Amherst College, was unanimously elected secretary; but his duties in connection with the college, and declining health, compelled him to decline the appointment, and Jan. 25, 1853, Charles L. Flint, a young lawyer just established in business in New York, was elected, and continued to hold the position until

his resignation was accepted, Aug. 25, 1880. On that day John E. Russell of Leicester was elected to succeed Mr. Flint, and at this meeting it was voted that the secretary of the Board be elected annually at the meeting in February, the term of service to be for one year, beginning with the first of July following the election. Mr. Russell continued in office until his resignation in 1887. F. H. Appleton of Peabody was elected to succeed him; but he withdrew his acceptance of the office before entering upon its duties, and on August 23 of the same year the present incumbent, William R. Sessions of Hampden, was elected.

The Board of Agriculture, at the present time, consists of the governor, lieutenant-governor, secretary of the Commonwealth, the president of the agricultural college, one person appointed from and by each agricultural society which receives an annual bounty from the Commonwealth, and three other persons appointed by the governor with the advice and consent of the council.

The first four are *ex officio* members; the latter serve for terms of three years each. At the present time there are forty-one members, which number will be increased to forty-five at the annual meeting in February next. The Board is required to meet at the State House, or at the Agricultural College, at least once in each year, and as much oftener as may be deemed expedient; and no member can receive compensation from the Commonwealth except for personal expenses when engaged in the duties of the Board, and to meet these expenses the sum of $1,900 was appropriated this year.

The Board may appoint and prescribe the duties of a secretary, who receives a salary of $2,500 a year; and who, at such times as the Board shall approve, may employ a clerk at a salary of $1,200 a year, and may expend for other clerical services in his office, and for lectures to be given before the Board at its annual or other meetings, a sum not exceeding $800. The secretary is also allowed $500 for traveling and necessary expenses while engaged in the performance of his duties. The Board are also overseers of the Massachusetts Agricultural College, with powers and duties defined and fixed by the governor and council; are empow-

ered to investigate such subjects relating to improvement in agriculture in this Commonwealth as they may think proper, and may take, hold in trust, and exercise control over donations or bequests made to them for promoting agricultural education or the general interests of husbandry; may fix the days on which the different agricultural societies shall commence their exhibitions, and may prescribe forms for and regulate the returns required of said societies, and shall furnish to the secretary of each society such blanks as they may deem necessary to secure uniform and reliable statistics; shall annually, by their chairman or secretary, submit to the general court a detailed report of their doings, with such recommendations and suggestions as the interests of agriculture may require.

The Board of Agriculture also acts as a board of forestry; has two of its members on the board of control of the State Experiment Station; determines the amount of bounty to which a society is entitled for any year, and may prescribe rules and regulations to societies for uniform modes of ascertaining the product of crops entered for premium.

It is the duty of the secretary of the Board in each year to cause to be made and published for distribution as full an abstract of the returns of the agricultural societies as he may deem useful; and he may also appoint one or more suitable agents to visit, under the direction of the Board, the towns of the Commonwealth, for the purpose of inquiring into the methods and wants of practical husbandry; of ascertaining the adaptation of agricultural products to soil, climate and markets; of encouraging the establishment of farmers' clubs, agricultural libraries and reading-rooms; and of disseminating useful information in agriculture by means of lectures or otherwise; and for this latter purpose the sum of $1,400 was appropriated this year.

By the regulations of the Board, an annual business meeting is held at the office of the secretary in Boston, commencing on the Tuesday preceding the first Wednesday in February, and continuing through the following Wednesday, on which day the new members may take their seats, and the meeting be prolonged as business may require. At this meeting an executive committee, consisting of five members, is chosen,

whose duty it is to act for the Board in cases of emergency; also a delegate is appointed to attend the fair of each society represented on the Board, who is to make report to the Board, at its next annual meeting, of the fair and of the condition and work of such society. The Board also holds an annual three days' public meeting for lectures and discussions, at such place within the Commonwealth as it may designate, beginning on the first Tuesday in December. It also requires that each agricultural society receiving the bounty of the Commonwealth shall arrange and hold not less than three farmers' institutes each calendar year within its limits, and the Board renders all the assistance in its power to make such institutes interesting and profitable. The secretary attends as many as is compatible with other duties of his office, and provides lecturers as far as the appropriation for this object will warrant.

There are also many other minor duties and requirements which want of space will prevent enumerating.

The secretary, from the nature of his position, early became the chief officer and organ of the Board, which in turn is the organ of the farming community. The office is placed near and connected with the government, so that the whole legislation in reference to bounties, premiums and general agricultural interest of the State is looked after and influenced by the department.

Since the formation of the Board, an entire change has taken place in public opinion with regard to the importance of agricultural education. It sustained and cherished the first general efforts for the establishment of the Massachusetts Agricultural College, now so favorably known and appreciated; it has done much for the improvement of the agricultural literature of the country, and in its office is gathered a valuable agricultural library of two thousand volumes; it originated the law for the protection of sheep and the law for the inspection of fertilizers, and appointed a State agricultural chemist; by its prompt and persistent action it greatly assisted the cattle commissioners in stamping out the plague of pleuro-pneumonia in 1860; it has brought together from time to time a band of the leading practical and scientific agriculturists, whose knowledge has

been given to the public through the medium of its reports; it was instrumental in the formation of the State Experiment Station; it has published thirty-seven annual volumes, containing 23,000 pages of matter pertaining to agriculture and kindred pursuits, and embracing in all an issue of 375,000 copies, which have gone out not only to the people of our own Commonwealth, but may be found in almost all of the civilized countries of the globe.

# LETTUCE AND CUCUMBER CULTURE UNDER GLASS.

*From Bulletin No. 2, Crop Report for June, 1890.*

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In presenting statistics relative to the culture of lettuce and cucumbers under glass, it should be stated that the facilities for collecting information of this character are not of the best, and consequently the work done is not as complete as could be wished, but it is believed that the following will give an idea of the extent and importance of this branch of agriculture.

Inquiries were extended to the culture in regular greenhouses, sash-houses and hot-bed sash, which latter are usually six feet by three in size. It was found that the culture varied with the locality and with different individuals in the same locality, and that the price received for the products varied with the quality, season of the year, state of the market, and the favorableness of the season to out-door culture.

Lettuce is generally considered a hard crop to grow, and it requires much care. It does best on new soil and in new houses. After growing lettuce for several years, it is found advisable to discontinue its culture for two or three seasons. Lettuce is affected by mildew, especially in old houses, in sash-houses and under sash. It is sometimes overcome by putting sulphur on the heating pipes, and allowing the fumes to pervade the house; sometimes by allowing the temperature in the house to fall to 32° F., and remain so over night; sometimes by steaming the house, and then thoroughly airing it; and sometimes the lower leaves of the plants are picked off, and the rest allowed to head. Tobacco smoke is generally used to destroy lice on lettuce, and sometimes

the tobacco stems are steamed, and the vapor used. It is said that tobacco water will spot lettuce if it comes in contact with the leaves. The lettuce season under glass is usually from September to May.

The cucumber season in houses is practically the whole year round, and under sash from March to July. Under the best culture, in houses, seventy-two days elapse between the setting out of the cucumber plants and the picking of the cucumbers. When cucumbers are grown under hot-bed sash, the sash and planks upon which they rest are usually removed about the first week in July, and the vines allowed to run. When grown in houses, the cucumber flowers are fertilized by bees, a hive of which is kept in or near the house for that purpose. The vines are affected, sometimes enough to destroy the crop, by plant lice, thrips, red spiders, black flies, timber rot, stump foot and foul soil. The best remedy for plant lice and thrips seems to be fumes from burning tobacco stems, and the odor arising from stems and dust strewn around on the ground. Too much tobacco smoke will cause the leaves to curl up. It is said that lice on cucumbers may also be destroyed by spraying with tobacco water. The red spiders may be destroyed by spraying with water, or by the use of steam. Considerable damage is done by timber rot, which frequently appears, especially in old houses, and may result from the decay of the flowers which have fallen upon the vines. It seems to be most common in cold, damp weather, in old houses. However, the nature of the trouble does not appear to be very well understood. In South Sudbury and Fitchburg some complaint was made of stump foot on cucumber and tomato vines.

On account of cold, cloudy, wet weather, the past year has been unusually bad for both lettuce and cucumbers.

In the vicinity of Boston, beets, radishes, dandelions, tomatoes and parsley are quite extensively grown as catch crops. It may be said that the culture of these several crops under glass is a paying business when good crops are obtained; but, as in other branches of agriculture, there are many failures and discouragements, and success is not easily attained.

*Arlington.* — There were found to be twenty-three regular greenhouses and four sash-houses in this town, owned by twelve parties. Eighteen of these houses were heated by steam and nine by hot water. Of the growers, six used steam and five used hot water, and one had both. The greenhouses covered about 92,000 square feet, or over two acres, and the sash-houses about 8,000 square feet, or a total of 100,000 square feet. In the houses the past year it is estimated some 400,000 heads of lettuce were grown, selling for $1.25 per dozen down, or an average of about 60 cents per dozen. It was largely marketed in Boston and New York. In these houses it is estimated 350,000 cucumbers were grown, selling for from 18 cents apiece down, or an average of about five cents. The cucumbers were largely marketed in Boston, but when that market was crowded were shipped to New York and Chicago. But very little lettuce was grown in the sash-houses. There were also some 27,000 sash used in the culture of cucumbers, and it is estimated that some 1,500,000 cucumbers were grown in this way. Probably 20,000 of these sash were used for lettuce, under which one, two, three and in some few cases four crops of lettuce were grown. It is estimated that 1,000,000 heads of lettuce were grown in this way, and that in this town, during the past season, over 1,400,000 heads of lettuce and some 1,850,000 cucumbers were grown under glass.

*Belmont.* — There were found to be nineteen regular greenhouses and seven sash-houses in this town, owned by eleven parties. Ten of the greenhouses and three of the sash-houses were heated by steam, and nine of the greenhouses and three of the sash-houses were heated by hot water, while one sash-house was without artificial heating apparatus. Of the growers, six used steam, four used hot water and one grower had both. The greenhouses covered about 78,000 square feet, or nearly two acres, and the sash-houses about 20,000 square feet, or a total of 98,000 square feet. In most cases two crops of lettuce were grown, occupying the houses from September to May. The cucumber season was from January to August. In these houses it is estimated 320,000 heads of lettuce and 275,000 cucumbers

were grown, and the market was practically the same as for Arlington. There were also about 9,000 sash used in the culture of cucumbers, and about 3,000 for lettuce. Under these sash it is estimated 80,000 heads of lettuce and 350,000 cucumbers were produced. It is estimated that 400,000 heads of lettuce and 625,000 cucumbers were grown under glass in this town.

*Fitchburg.* — There were found to be thirteen greenhouses in this city, owned by nine parties, and all heated by hot water. Only two crops of lettuce were grown in one house, the other houses being devoted to cucumbers. The lettuce crop began to mature in September, and lasted until April. Some 6,000 heads of fair quality were grown, selling for from 50 cents to $1.00 per dozen, or an average of about 75 cents. The cucumbers began to mature in November, and lasted until July. About 50,000 were grown, selling for from 3 to 30 cents apiece, or an average of from 10 to 14 cents. The market was largely in Boston, some in New York. No one had entire success this year, while in some cases the failure was nearly complete. Thrip and aphis were unusually prevalent, and some notwell-understood diseases stood in the way.

*Leominster.* — There were found to be nine greenhouses in this town, covering some 26,000 square feet, and heated by hot water. The cucumbers were started in the open air the middle of August, and transplanted to the house about the middle of September, and picking began about the middle of October. The vines were allowed to bear as long as they would, were then removed, and another set put in their place. It is estimated that 100,000 cucumbers were grown, which sold in the winter for from 10 to 23 cents apiece, or an average of about 17 cents. The market in winter and early spring was New York and Chicago, and in spring and early summer some were also sent to Boston. They were shipped pressed in bushel boxes. The black fly and thrip were the only obstacles to their culture.

*Marlborough.* — There were found to be four greenhouses in this place, all of which were heated by hot water, and covered some 10,000 square feet. The cucumber season lasted from October to July. When the vines of the first

crop were through bearing, they were pulled up, and other vines put in their place. About 22,000 cucumbers of fair quality were grown the past year. One grower with two houses only grows one crop of cucumbers in the fall, and then runs tomatoes. The price received ranged from 5 to 25 cents apiece, with perhaps an average of 10 cents apiece. The market was New York, Boston and home. No lettuce was grown in greenhouses, but about 15,000 heads were grown in hot-beds.

*Newton.* — There were found to be twelve greenhouses in which cucumbers and lettuce were grown, covering some 55,000 square feet, and heated by hot water. Usually three crops of lettuce were grown, the first crop being started in September. After the lettuce crops were over, cucumber vines were started, and about June 1 the growers began to pick the cucumbers. Some 200,000 heads of lettuce were grown, selling for an average price of about 40 cents per dozen. It is estimated some 150,000 cucumbers were grown; but, owing to their lateness, the average price received was hardly more than $2\frac{1}{2}$ cents apiece. The market was Boston and local.

*Revere.* — There were found no regular greenhouses in this town, but three sash-houses, covering about 9,000 square feet, and heated by hot water. In two of these houses cucumber plants were set about May 20, and the cucumbers were picked until September. About 30,000 cucumbers were grown in the houses. About 4,000 sash were used for out-door culture, and it is estimated that 170,000 cucumbers were grown this year in this way. Two thousand sash were used for lettuce last winter. The plants were set December 1, and were all gone February 1. The second crop came off April 1. About 150,000 heads were grown in this way, selling for an average price of 50 cents per dozen. In one sash-house two crops of lettuce were grown, and then cucumbers. Probably 150,000 heads of lettuce were grown under glass in town, and about 200,000 cucumbers, the past year. The market was Boston.

*Sudbury.* — There were found sixteen growers in this town, mostly in South Sudbury, having thirty-one houses, in which cucumbers were grown a part or all of the year.

These houses covered some 46,000 square feet, and, with two minor exceptions, were heated by hot water. Usually only one crop of cucumbers was grown, and the houses were occupied the rest of the year with beets, radishes, tomatoes, parsley and flowers. It is estimated that some 150,000 cucumbers were grown in these houses, selling for from 2 to 30 cents apiece. The market was Boston, sometimes New York. Red spiders, aphis, thrip, black lice and stump foot have bothered the past year. Very little lettuce was grown. Quite a large amount of tomatoes and flowers were produced. There were also some 600 sash, under which some 25,000 cucumbers were grown.

*Templeton.* — There were found to be three greenhouses in this town, covering about 5,000 square feet, and heated by hot water. Two crops of cucumbers were grown, occupying the houses nearly the entire year. The past year some 25,000 No. 1 cucumbers were grown, selling in New York and Boston markets for from 6 to 33 cents apiece, or an average of 15 cents. Also, some 2,500 No. 2, selling in home market for from 3 to 10 cents apiece, or an average of 6 cents. One crop in one house was destroyed by green flies, and the best remedy seemed to be to pull up the plants, fumigate heavily with tobacco smoke, and start anew. But little lettuce was grown under glass in this vicinity, and that was started so as to be ready about June 5. Perhaps 2,000 heads were grown, selling for an average of 50 cents per dozen.

*Winchester.* — There were found to be five regular greenhouses and two sash-houses in this town, owned by three parties; and, with the exception of one sash-house which was without artificial heating apparatus, all were heated by hot water. The greenhouses covered some 18,000 square feet, and the sash-houses some 6,000 square feet, or a total of 24,000 square feet. Last season some 16,000 heads of lettuce were grown in these houses, which sold in Boston markets for from $1.25 per dozen down. It is estimated that 100,000 cucumbers were grown in these houses. Also some 14,000 heads of lettuce were grown under some 400 sash, and some 2,500 sash were devoted to cucumbers, under which some 125,000 cucumbers were produced. It is esti-

mated that during the past year 225,000 cucumbers and 30,000 heads of lettuce were grown in this town. The price received for cucumbers ranged from 18 cents apiece down. The market was Boston.

These industries are carried on to a small extent in many other places in the Commonwealth, among which are Allston, Brookline, Swansea, Watertown, Waltham, Framingham, Worcester, Shrewsbury, Westborough, Concord, Ashby, Lowell, Franklin and Lexington. It is estimated that in the State during the year ending September, 1890, some 1,000,000 heads of lettuce and 1,200,000 cucumbers were grown in houses, and some 1,300,000 heads of lettuce and 2,500,000 cucumbers under hot-bed sash, or a total of 2,300,000 heads of lettuce and 3,700,000 cucumbers as the product under glass for the year. Estimating 30 cents per dozen to be the average price received for the lettuce, would make its value about $60,000; and estimating that the cucumbers averaged 3¾ cents apiece, would make their value about $140,000, or a total of some $200,000.

# THE GRAPE INDUSTRY IN MASSACHUSETTS.

*From Bulletin No. 4, Crop Report for August, 1890.*

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The vine is indigenous in this country, and was found in profusion by the Northmen in their discoveries on this continent more than eight hundred years ago, inducing them to name the country "Vin-land dat gode" (the good wine-land).

Our native varieties, called "fox grapes," characterized by their hard pulp, thick skins and pungent aromatic flavor, are found in every kind of soil and situation. "Here are grapes," wrote Edward Winslow in 1621, "white and red, and very sweet and strong also."

Plants and seeds of foreign varieties were brought to this country by colonists during the first fifty years after its settlement, but no considerable attention seems to have been given to their propagation until after the close of the Revolutionary War, when efforts began to be more especially directed to the cultivation of various kinds of fruit. Among these, though not the most prominent, was the grape.

Experience soon showed that these foreign varieties would not withstand the severity of our New England winters without protection; and that our short and variable summers and early autumnal frosts presented an insurmountable barrier to their successful cultivation except under glass.

These efforts in relation to grapes of foreign origin having failed, the attention of the fruit grower was wisely directed to the examination of our more hardy native varieties. By a careful selection of the most promising for propagation, and by reproduction, several new varieties were obtained, of acknowledged excellence and well adapted to our New England climate. Prominent among the varieties obtained from the native grape were the Isabella and Catawba, excellent grapes where the climate permitted them to ripen, but

too late for our New England climate, except in the most sheltered situations, and uncertain even there.

It was not until these varieties appeared that our people took much interest in the cultivation of this fruit, and even then but here and there a vine could be found on our northern farms. Later the Diana was added to the list, and others of lesser note; but the honor of giving a grape to the country that was to be extensively cultivated and highly prized from the extreme East to the extreme West, was reserved for one of our own citizens; and when Mr. Bull sent out his Concord grape, he conferred a great boon upon the country. This variety was a seedling from a seedling of the wild grape, *Vitis Labrusca.*

In 1862, according to John B. Moore, there were five vineyards in Middlesex County, from one-half to one acre each; viz., one in Acton, one in Dracut, and three in Concord. Two of these vineyards had been planted only one year, and the other three were bearing fruit.

Said Mr. E. W. Bull in 1865, "The cultivation of the grape in the open air is to-day an assured fact. More than thirty acres are planted in Middlesex County alone, not counting the small holdings;" and in 1866 the same gentleman said that more than one hundred acres of grapes were grown in Massachusetts, and that he assumed that the growing of the grape in the open air was demonstrated, and that the vineyard was established in Massachusetts.

The following table will illustrate the growth of the grape industry in Massachusetts during the twenty years from 1865 to 1885, inclusive: —

| | Currency Values. | | Gold Values. |
|---|---|---|---|
| | 1865.* | 1875.† | 1885. |
| Ordinary, bushels, | 887 | 19,836 | 51,852 |
| Total value, | – | $32,635 | $58,650 |
| Value per bushel, | – | $1 65 | $1 13 |
| Best, including hot-house, pounds, | 24,415 | 267,617 | 1,420,564 |
| Total value, | – | $34,624 | $58,372 |
| Value per pound, | – | $0 13 | $0 041 |
| Aggregate value, | $40,100 | $67,259 | $117,022 |

* Premium, 1.57. † Premium, 1.12.

In 1875 there were 224,352 vines, and in 1885, 356,976. These latter were owned by 18,112 persons, in 337 cities and towns, and their average value was ninety-seven cents per vine. In the decade from 1875 to 1885, ordinary grapes decreased 23.13 per cent and best 64.69 per cent in value, while ordinary grapes increased 161.40 per cent and best 439.82 per cent in quantity.

The following table, compiled from the census of 1885, will show in which counties this industry is most largely carried on: —

| COUNTIES. | Bushels of Ordinary Grapes. | Value. | Pounds of Best, including Hot-house. | Value. | Aggregate Value. |
|---|---|---|---|---|---|
| Barnstable, . | 968½ | $1,339 | 3,955 | $340 | $1,679 |
| Berkshire, . | 812 | 1,244 | 16,368 | 890 | 2,134 |
| Bristol, . . | 3,748¼ | 4,776 | 41,545 | 6,118 | 10,894 |
| Dukes, . . | 120 | 172 | 3,080 | 159 | 331 |
| Essex, . . | 4,402 | 5,805 | 61,168 | 8,744 | 9,549 |
| Franklin, . | 2,057½ | 2,622 | 16,677 | 738 | 3,360 |
| Hampden, . | 3,075½ | 3,258 | 27,524 | 966 | 4,224 |
| Hampshire, . | 2,612½ | 2,509 | 22,718 | 950 | 3,459 |
| Middlesex, . | 13,036¼ | 13,461 | 735,714 | 25,883 | 39,344 |
| Nantucket, . | 15 | 18 | 1,400 | 106 | 124 |
| Norfolk,. . | 4,406 | 5,055 | 87,896 | 2,784 | 7,839 |
| Plymouth, . | 1,987¾ | 2,880 | 50,062 | 2,248 | 5,128 |
| Suffolk, . . | 349½ | 874 | 13,580 | 748 | 1,622 |
| Worcester, . | 14,261¼ | 14,637 | 338,877 | 12,698 | 27,335 |
| Aggregates, | 51,852 | $58,650 | 1,420,564 | $58,372 | $117,022 |

Billerica, in Middlesex County, produced 1,734 bushels of ordinary and 101,640 pounds of best; Concord, in the same county, 312 bushels of ordinary and 150,119 pounds of best; Harvard, in Worcester County, 256 bushels of ordinary and 127,877 pounds of best; Ashby, in Middlesex

County, 38 bushels of ordinary and 87,460 pounds of best; and Fitchburg, in Worcester County, 179 bushels of ordinary and 72,866 pounds of best.

In order to ascertain the condition of the grape industry at the present time, and the outlook for this year's crop, a special circular was prepared and sent to parties in some forty of the towns in which this industry is most largely carried on, as indicated by the census of 1885.

From the returns received it is estimated that there are not less than 275 acres at the present time devoted to grape culture in vineyards, and that the Concord, Moore's Early and Worden are the varieties most generally grown. In some sections grapes are also grown in houses, but it is believed not to any great extent for market.

The following reports will indicate the acreage of and prospect for this year's crop in what might be called the grape centres of the Commonwealth: —

*Amherst.* — Six acres in vineyards, one-half young; Concord, Moore's Early and Worden most largely grown; crop promises to be more than an average in quantity and quality; estimated yield, three and one-half tons; crop usually marketed in Worcester; grape culture in vineyards not increasing very much.

*Ashby.* — Forty acres in vineyards; Concord, Moore's Early, Niagara and Worden most largely grown; crop promises to be an average one in quantity and quality; estimated yield, seventy-five tons; crop usually marketed in Boston, and five cents per pound net the price received last year; grape culture in vineyards not increasing; little trouble from disease or insects so far this season. Grapes grown in two houses in town; one containing twenty-seven hundred square feet, hot-water heater; varieties grown, Black and Muscat Hamburg, Alicant, Gros Colman; other house one thousand square feet; no heat; varieties grown, Hamburg and Alicant.

*Berlin.* — Five acres in vineyards; mostly Concord; crop promises to be more than an average; estimated yield, six and one-half tons; marketed in Boston, Worcester and neighboring towns; average price per pound received last year, seven cents; grape culture in vineyards not increasing in this town.

*Billerica.* — Twenty-six acres in vineyards; varieties, mostly Concord, Moore's Early and Niagara; this year's crop does not

promise to be an average one; estimated yield, not over two tons; crop usually marketed in Boston and Lowell. Growers are discouraged by repeated failures, and many acres have been pulled up and more are about to be. One extensive grower says that by the liberal use of air-slaked lime his crop is saved, and is the best he ever had; half the number of boxes, but the largest clusters.

*Concord.* — Ninety acres in vineyards; Concord and Moore's Early the chief varieties grown; this year's crop promises to be below an average in quantity and quality; market, Boston; price received last year, from one to twelve cents per pound; grape culture in vineyards not increasing in this town; rot is the chief drawback, and it has increased greatly in the last two years.

*Fitchburg.* — Perhaps ten acres in vineyards; Concords most largely grown, some Delaware and Worden; promise of about three-fourths of a perfect crop, with little rot or other disease, and the prospect now of a good quality if conditions remain favorable; estimated yield, twenty to twenty-five tons; market mostly Boston, and average price received per pound last year six cents; grape culture in vineyards not increasing.

*Harvard.* — Between thirty and fifty acres in vineyards; Concords most largely grown; crop rotting badly, having begun about August 12. Before that, gave promise of more than an average crop; estimated yield, perhaps thirty tons; market usually Boston; grape culture in vineyards not increasing.

*Littleton.* — Four to five acres in vineyards; Concord and Moore's Early the principal varieties grown; this year's crop does not promise to be an average one; estimated yield, three to four tons; market, Boston; grape culture in vineyards not increasing in this town.

*Marlborough.* — Between three and four acres in vineyards; almost wholly Concord; this year's crop promises to be an average one in quantity and quality; estimated yield, about seven tons; crop usually marketed in Boston, Worcester and local; culture in vineyards not increasing to speak of. One man raises such fine grapes that he receives several cents more per pound than the rest.

*Middleborough.* — Four acres in vineyards; Concord; this year's crop does not promise to be an average one in quantity and quality; marketed mostly at home and in adjoining towns; chief drawback low prices. None grown in houses for sale. Last

year's prices are no criterion, as it was an unusually wet season, and grapes did not ripen.

*Sherborn.* — About ten acres in vineyards; Concord; crop does not promise to be an average one; market, Boston; grape culture decreasing in this town; little money made on them the past ten years.

*Shrewsbury.* — Ten acres in vineyards; Moore's Early, Concord, Worden; crop promises to be an average one in quantity and quality; estimated yield, seven tons; crop marketed in Worcester; average price per pound received last year, seven cents; grape culture in vineyards is increasing in this town.

*Westborough.* — Possibly four or five acres in vineyards; mostly Concord; crop will hardly be an average one; estimated yield, eight to ten tons; some of crop goes to Boston, but most is marketed in town; grape culture in vineyards not increasing. There are three or four small houses, most of which are heated by hot water.

A warm, dry soil is best suited to the grape; and a south slope, with shelter of wood or belts of trees on the north-east and west to prevent the winds from blowing away the hot air created by the heat of the sun, is always desirable.

With careful management, grapes can be profitably grown in favorable localities in Massachusetts, and a ripened crop be depended upon four years out of five. The profit depends largely upon the care and economy exercised by growers in all the details of the work. The production is so abundant that there is little or no profit to the ordinary grower, but to the painstaking cultivator a superior article still furnishes a fair remuneration.

It is not the purpose of this article to create a boom in grape culture, or to encourage farmers to rush into the business, but to show that in favorable localities the grape crop may be made a source of profit.

There is liability to overproduction, but it is safe to assume that a first-class article will always find a market.

All crops are liable to injury from insects, diseases and unfavorable atmospheric conditions, and the grape crop is no exception.

The chief drawbacks to the cultivation of this excellent fruit are low prices, caused by competition from points far-

ther west, rot, mildew, early frosts, and rose bugs. The destruction by insects and mildews is largely the result of poor cultivation and lack of care.

The following, condensed from Bulletin XIX., August, 1890, of the Cornell University Agricultural Experiment Station, Ithaca, N. Y., may be of interest and value to grape growers in this State: —

"We warn our readers not to put faith in statements that certain varieties of grapes are exempt from diseases, for some of the most serious cases which we have seen this year were noticed upon a variety which has been said to be free from attack. The advent of rots and mildews is not a cause for alarm. They are to be expected, and they will undoubtedly spread. But the means are at hand to keep them in check easily and economically. The mildews and rots can be kept in check by the timely and persistent use of Bordeaux mixture. Begin before the flowers open, and spray every week or ten days until well into August. For anthracnose (the fungus which causes the scab of the berry and on the wood causes black, shallow pits), sulphate of iron applied before the leaves appear is probably the best remedy. After treatment should be made with Bordeaux mixture."

Experiments have shown that girdling the grape vine makes a decided gain in the time of ripening of the fruit; that there is no loss of sugar, and that the increased size of the fruit makes it very attractive, and more than makes up for any increased softness of the berry.

# THE DAIRY INDUSTRY IN MASSACHUSETTS.

*From Bulletin No. 6, Crop Report for October, 1890.*

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An idea of the extent and importance of the dairy industry is gained when it is considered that, according to the census of 1885, of the $47,756,033 worth of agricultural products, $13,080,526, or 27.39 per cent, were classed as dairy products; while hay, straw and fodder came second, with $11,631,776, or 24.36 per cent; and vegetables third, with $5,227,194, or 10.95 per cent. Of the dairy products, milk represented $10,312,762, or 21.60 per cent; butter, $2,531,071, or 5.30 per cent; cream, $202,706, or 0.42 per cent; and cheese, $33,987, or 0.07 per cent. Adding the value of the dairy products classified as food preparations in the volume of manufactures, the aggregate swells to a round $13,250,000.

The following table, compiled from the census of 1885 (agriculture), will illustrate the growth of this industry during the forty years from 1845 to 1885 inclusive. To this table are also added statistics from the same source, relative to beef and veal: —

| | Gold Values. | | Currency Values. | | Gold Values. |
|---|---|---|---|---|---|
| | 1845. | 1855. | 1865.* | 1875.† | 1885. |
| Butter, pounds, | 7,688,556 | 8,116,009 | 3,745,293 | 7,922,431 | 9,685,539 |
| Total value, | $1,116,709 00 | $1,678,558 00 | $1,360,248 00 | $2,747,878 00 | $2,531,071 00 |
| Value per pound, | 15 | 21 | 36 | 35 | 26 |
| Cheese, pounds, | 7,262,637 | 5,762,776 | 3,560,481 | 1,280,234 | 359,124 |
| Total value, | $398,174 00 | $464,251 00 | $582,353 00 | $162,826 00 | $33,987 00 |
| Value per pound, | 05 | 09 | 16 | 13 | 095 |
| Cream, gallons, | - | - | - | - | 263,158¾ |
| Total value, | - | - | - | - | $202,706 00 |
| Value per gallon, | - | - | - | - | 77 |
| Milk, gallons, | 2,850,412 | 3,300,916 | 10,079,180 | 35,698,159 | 72,528,628 |
| Total value, | $304,917 00 | $755,888 00 | $1,956,187 00 | $5,934,671 00 | $10,312,762 00 |
| Value per gallon, | 11 | 23 | 19 | 17 | 14 |
| Beef, pounds, | - | - | 70,825,396 | 12,258,542 | 10,668,941 |
| Total value, | $225,918 00 | - | $8,188,564 00 | $1,068,154 00 | $718,932 00 |
| Value per pound, | - | - | 12 | 09 | 067 |
| Veal, pounds, | - | - | 4,977,436 | 3,598,942 | 4,570,870 |
| Total value, | - | - | $562,895 00 | $363,517 00 | $391,169 00 |
| Value per pound, | - | - | 11 | 10 | 086 |

* Premium, 1.57. † Premium, 1.12.

In the column for 1885 are included the total quantity and value of milk at the price of new milk, the total quantity and value of cream sold or used as cream, and the total quantity and value of butter and cheese made on farms.

The number and value of the animals associated with the dairy industry is important in this connection; and it is found that the census of 1885 gives the number of milch cows on farms as 162,847, valued at $6,156,130; and the number of other bovine animals as 99,339, valued at $2,331,-852; or a total of 262,186 animals, valued at $8,487,982.

In the aggregates of polls, property, taxes, etc., as assessed May 1, 1885, the number of cows is given as 167,-817, and the number of neat cattle other than cows as 57,044, or a total of 224,861: while the number as assessed May 1, 1889, is found to be 192,307 cows and 63,884 neat cattle other than cows, or a total of 256,191.

According to the census of 1885, the value of the manure made on farms is given as $3,090,189; and it is estimated that not less than $2,000,000 of this amount can be credited to the dairy industry. Also, the production of pork is given as 16,546,752 pounds, valued at $1,063,180; and the making of this pork to a large extent depends upon the use of the so-called wastes of the dairy.

From the table it would appear that from 1875 to 1885 cheese fell off apparently nearly three-fourths as regards quantity. This is a fact, no doubt, as regards the farm; but the statistics of manufactures, under which heading cheese is now returned as a food preparation, show that this decrease in quantity is due largely to a change rather from agriculture to manufactures. In the volume on manufactures we find credited under food preparations 613,087 pounds of cheese, valued at $65,491: which, added to the amount reported as made on farms, swells the aggregate to 972,211 pounds, valued at $99,478.

In Massachusetts the first cheese factory went into operation in April, 1864. Under a call signed by Dwight Ellis of Warren and a few others, a meeting was held in West Brookfield, Feb. 1, 1866, at which the Massachusetts Cheese Manufacturers' Association was formed. At this meeting four factories reported having made an aggregate of 364,178

pounds of cheese during the season of 1864, the net price of which was $19.60 per hundred pounds. During 1865 eleven factories were in operation, — some of them, however, only a short time, — and the same number in 1866.

In the latter year nine of them reported an aggregate capital invested of $44,866.57: that the whole amount of milk was 10,604,518 pounds, from which was made 1,072,705 pounds of cheese, which brought to the farmers, after paying all expenses, $175,240.62. Early in 1869 it was reported that there were not less than twenty factories in successful operation in Massachusetts. Ten of these reported an aggregate of 1,095,850 pounds of cheese made in 1868. The aggregate capital in 1871 of thirteen factories was reported as about $60,000; that 10,233,450 pounds of milk were used and 948,876 pounds of cured cheese produced. Of these factories the New Braintree led, with an invested capital of $9,000; using 1,679,351 pounds of milk, making 165,552 pounds of cured cheese, yielding a net income of $10.71 per hundred pounds. It is impossible at the present time to state the date when this association was dissolved. "The organization had its inception at the time of the introduction of the factory system of making cheese. The factory at Brimfield and the South Factory at Barre started the same year, and were the first in the New England States to adopt the system. It was a new era in the dairy business. The meetings of the association lasted two days and one evening, with lectures from the best then known speakers, — very much such meetings as the Board now hold. Probably they were a stimulus to the Board, and, indirectly, the mother of 'farmers' institutes;' and they only ceased when the Board and institutes took up the work, and the selling of milk became better than cheese-making with Canada to compete with."

The exact number of cheese factories now in operation in the Commonwealth is not known, but it is believed there are but four. Returns from a portion of these only have been received. It is estimated, however, that these factories in 1889 made about 150,000 pounds of cheese, using some 1,750,000 pounds of milk, and netting about 9 cents per pound. In Boston the last seven months the wholesale

price of best cheese has ranged from 9 cents to 12 cents per pound; and the retail price of old cheese has ranged from 19 cents to 20 cents, and new cheese from 10 cents to 16 cents per pound.

In the census of 1885 (manufactures) the product of creamery butter is given as 7,800 pounds, valued at $2,700, and the amount of butter not specified as 189,545 pounds. Most of the twenty-seven co-operative creameries (or butter factories) now making butter were established since this census was taken, and returns to this office in January last from the twenty-four then in operation gave the amount of butter made in 1889 as 2,193,983 pounds, selling at an average price of about 26 cents per pound, or an aggregate of some $570,000.

There are also three co-operative milk associations, making butter from their surplus milk: and in 1889 it is estimated that they made some 135,000 pounds. Considerable butter is also made by milk contractors from surplus milk. Probably the amount of butter made on farms has been somewhat lessened by the establishment of co-operative creameries, but it is impossible to state to what extent.

As illustrative of the condition of the butter market in Boston during the past six months, the following compilation from the market reports of the "New England Farmer" is given: —

May 1. — Butter market remains in good, healthy condition. Arrivals of choice fresh creamery taken as fast as they arrive. It is estimated that last year's business shows 50,000 tubs as an actual surplus over consumption, which was the cause of the great depression in the market which was so marked during January and February. The bulk of this was sold at great loss to the holders. The market reporter of the "Boston Journal" states that the money lost by Boston butter men during the last twelve months must have been not less than $100,000. Prices quoted: *Wholesale.* Extra creamery, 20 and 21 cents; firsts and extra firsts, 15 and 19 cents; New England dairy, 12 and 16 cents. *Retail.* Print, 28 and 30 cents; best tub, 25 and 28 cents; good tub, 15 and 18 cents.

June 1. — For the first time this spring, butter has begun to accumulate this week, which makes the market very weak and shaky. The quality of the butter coming in is improving. Prices

quoted: *Wholesale.* Extra creamery, 15 and 16 cents; firsts and extra firsts, 11 and 13 cents; New England dairy, 10 and 13 cents. *Retail.* Print, 25 cents; best tub, 23 cents; good tub, 15 and 18 cents.

July 1. — Butter market has ruled firm on fine grades during the week, with a pretty good trade. Consumption is running along at a full rate. Buyers for cold storage seem determined to hold off, if they cannot get what they want at low prices. Prices quoted: *Wholesale.* Extra creamery, 15 and 15½ cents; firsts and extra firsts, 11 and 13 cents; New England dairy, 10 and 12 cents. *Retail.* Print, 25 cents; best tub, 23 cents; good tub, 15 and 18 cents.

August 1. — The condition shows a tendency to improve, although the general market is as yet dull and trade is flat, much of the receipts of ordinary grades going into cold storage. But for the best butter there is an improved demand, and the receipts are not large enough to supply it. The shrewdest judges claim that the production of butter so far this year has been less than it was a year ago, and that there are from 25,000 to 30,000 fewer packages in cold storage. Prices quoted: *Wholesale.* Best New England creamery, 19 and 20 cents; extra firsts, 15 and 17 cents; choice New England dairy, 16 and 17 cents; common grades as to quality down as low as 6 cents. *Retail.* Print, 25 cents; best tub, 23 cents; good tub, 15 and 18 cents.

September 1. — The advance still continues, but is getting to such a point that consumers are remonstrating, and, if it goes much higher, the inevitable reaction will follow. Prices quoted: *Wholesale.* Best New England creamery, 24 and 25 cents; fine dairy selections, 21 and 22 cents; average lots, 17 and 20 cents. *Retail.* Print, 30 and 33 cents; best tub, 28 and 30 cents; good tub, 18 and 22 cents.

October 1. — Market in a good, healthy condition. Trade is inclined to be dull. The books of the chamber of commerce show that September receipts run ahead of last year; but the total receipts for the past five months are smaller than for the same time a year ago, — a decrease of about 40,000 tubs, as compared with last season. Prices quoted: *Wholesale.* Best New England creamery, 24 and 25 cents; fine dairy selections, 19 and 21 cents; average lots, 16 and 18 cents. *Retail.* Print, 30 and 35 cents; best tub, 30 and 33 cents; good tub, 20 and 25 cents.

November 1. — Butter market in a firm, healthy condition. Fine fresh receipts are kept sold up, and, although the production is unusually large for the season, there is no accumulation in any grade. The prevailing opinion is that prices will go no lower,

and that the next change will be an upward one. Prices quoted: *Wholesale.* Best New England creamery, 25 and 26 cents; fine dairy selections, 20 and 22 cents. *Retail.* Print, 33 and 35 cents; best tub, 30 and 33 cents; good tub, 20 and 25 cents.

In referring to the milk industry, it is necessary to consider it from the Boston stand-point, as most of the surplus milk produced is bought by contractors and disposed of in said city. Last spring the contract agreed to by the committees of the milk contractors and the producers' union was that the price of milk in Boston for the six months commencing April 1, 1890, should be 32 cents per can of $8\frac{1}{2}$ quarts. The contractors agreed to pay the regular price for all milk for use as milk (or cream), and 5 per cent additional as a "margin;" but for the excess beyond this (known as "surplus milk") they were to pay its value for butter purposes, the price depending on the jobbing price of fresh creamery butter and the grading of prices of milk (owing to the varying conditions at different points) to be arranged between each route (or car) and its own contractor. For the six months commencing Oct. 1, 1890, it is thought the price will be 36 cents per can of $8\frac{1}{2}$ quarts. The producers want 38 cents, and offer to compromise on 37 cents; but the contractors say that they can get all the milk they need for 36 cents. The average freight on the milk that comes to Boston is about 10 cents per can. Taking out one cent per can for surplus, leaves 25 cents per can the winter average, and 21 cents the summer average at the car. This gives the producer on the average about 3 cents per quart in winter, and $2\frac{1}{2}$ cents in summer. From this must be deducted the cost of getting the milk to the car.* The retail price of milk in Boston is from 7 to 8 cents per quart from October 1 to April 1, and from 6 to 7 cents the rest of the year.

The following, condensed from the thirty-first annual report of the inspector of milk and vinegar of the city of Boston, 1889, will be of interest in this connection: —

"Estimated number of quarts of milk for average daily consumption in 1889 was 207,493. It can be said that the

* Bulletin No. 2, June, 1890.

quality of the milk of Boston, as a whole, is very good. For the proper enforcement of a law to prevent the adulteration of milk, it is necessary that a certain fixed standard of quality shall be prescribed. In this Commonwealth the statute requires that, to be of good standard quality, milk must yield on analysis not more than 87 per cent of watery fluid, nor less than 13 per cent of milk solids, nor less than 9.75 per cent of milk solids exclusive of fat, except during the months of May and June, when it shall contain not less than 12 per cent of milk solids.

"The only methods of adulteration at all employed are the very simplest possible, and include skimming, watering and coloring. Milk, as purchased in Boston, has commonly passed through several hands: the producer, the contractor, the dealer who delivers from a wagon, and to a great extent the shop-keeper. The practice of adulteration is not confined to any class of dealers, and is carried on by individuals in any branch of the business, who are tempted to larger profits than they can justly earn: for a man is not necessarily honest because he is a producer, nor is he to be considered dishonest merely because he drives a milk wagon or sells milk over the counter. In several instances complaints against milkmen have been withdrawn, on satisfactory evidence that the dairies supplying them were at fault. Of store-keepers it may be said that many of them keep milk for sale merely as an accommodation to their customers, and not for profit, and that as a rule they deliver the milkas it is received. Of those who sell from wagons, the majority never tamper with their milk; many do occasionally, especially when the supply runs short; and others are habitually dishonest. The addition of coloring-matter to milk is done almost wholly after it leaves the hands of the producers. The materials used for this purpose are caramel (burnt sugar) and annotto."

# CATTLE COMMISSIONERS' REPORT.

*To the Honorable Senate and House of Representatives of the Commonwealth of Massachusetts.*

In making their annual report, the Cattle Commissioners have nothing specially new to communicate. No contagious disease with which we were not previously familiar has attacked our domestic animals, though in one case it has apparently so increased as to require our official action. The State has been entirely free from certain diseases which in some former years have caused our people much alarm, and which have been suppressed at great expense. Glanders or farcy has always been here, and, so far as our observation can determine, will always remain, because of the importation of infected animals from other States. It is probable that our utmost efforts will only result in keeping the disease in abeyance, and the great mass of our equine stock free from its infection. During the year we have been notified of about ninety suspected cases; some of them proved to be catarrh or caries, but most were certainly glanders; about ten per cent of these were killed by the voluntary act of their owners, and the remainder by order of the Commissioners. This is a larger number than was destroyed by us the previous year, but is about the general average, and does not indicate a greater prevalence of the trouble. Not only horses and mules, but men, are susceptible to this contagion; and, so far as the medical faculty know, a case of it was never cured, which fact should cause it to be greatly feared, and lead all persons, whether owners of such stock or not, to heartily co-operate with the authorities in discovering and suppressing it. We find it in two forms, — acute and chronic; the latter making

the work of the commission tedious, difficult and unsatisfactory, for two reasons: first, because the possible presence of catarrh or caries makes a diagnosis somewhat uncertain, and a long isolation necessary, that development may change doubt to certainty; second, because a class of quacks claiming wonderful knowledge of diseases and medicines, and who have need of the avails of practice, pretend to be able to cure it permanently, and the owner of a valuable horse, hoping that such is the fact, is willing to grant him a trial, and earnestly pleads the stay of the law for that purpose. We have good reason to believe there are in the State well-educated veterinarians who are so unmindful of their duty, of the law and its penalties, that cases of the disease of which they become cognizant in the ordinary course of practice are not reported to the proper law officers.

We are yet frequently notified of supposed cases of hog cholera, a very few of which, however, are this disease. These cases are generally where the food given the animals is swill gathered in cities and large towns, against the use of which swine breeders have been repeatedly warned; in fact, all the cases of this disease which have come to our notice have been traced either directly or indirectly to the use of this food. For this reason, more than two years ago we issued a regulation to all our municipal officers, directing them to visit and examine all reported cases, and, if satisfied that the disease was present, to separate the sick animals from the healthy, and to cause strict isolation of the whole herd, to protect the public, and to take no further action. That regulation has not been rescinded, and officers should see that it is strictly enforced.

There has been no devastating or malignant contagion among the neat stock of the State, or any general deterioration of its health or usefulness. Annually for several years we have reported the existence of tuberculosis in the State, of our action respecting it; and on more than one occasion described in minute detail its lesions and general characteristics, have indicated its probable extent, and the direction of its dangerous tendencies. Careful observation during the last year fails to convince us that this disease is becoming

more prevalent; but the published experiments of sundry investigators, the zeal of veterinarians for the public welfare or their own personal interests, have pointed out the methods by which it is propagated, and newspaper reporters have aroused public attention to the matter by sensational or erroneous reports of a very few special cases. The disease is and has been here ever since white men or cattle occupied the land. At considerable intervals we find it in single cases among large herds in all parts of the State; occasionally, under peculiar circumstances of hunger, exposure and bad hygienic conditions, it is almost epidemic; and the same has been true when the latter conditions have been reversed. Though not unmindful of these facts, we see no occasion for alarm, but only for well-directed vigilance. We do not believe the pecuniary interests of our stock growers or the public health of our people require the application of the extreme provisions of the pleuro-pneumonia law to this disease; and, further, if it was applied, and millions of dollars expended in its execution, it would be of no avail unless the State could be securely isolated from all mankind, and all animals beyond its border. Believing these statements to be facts, we have thought the best course for us to pursue to curtail the prevalence of the disease among cattle directly, and among humans indirectly, was by inspection and elimination, it being the same we have followed with the contagion of glanders. The question of protecting the public health from the food products of our herds which might possibly be infected by this disease, is a different one from that of curtailing the spread of the disease among cattle, and is within the province and line of duty of the local boards of health of our cities and towns, or of the inspectors of food and provisions which the towns and cities may appoint.

Several attempts in this direction have been made by boards of health during the year, but notably in Waltham and Medford. In the former place information was received by the board of health that on a certain farm producing market milk one animal had died and another was infected with tuberculosis out of a herd of twelve. Thinking it to be their duty, they examined the premises and the herd,

found all the animals in good condition and in apparent health, food good and abundant, and hygienic conditions unexceptionable; but, from the statement of a veterinarian that one of the cows had a tuberculous development in her udder, they ordered the isolation of the whole herd, forbade the owner from selling his milk without an examination to see if it was infected by the disease, and notified the Cattle Commissioners of a case of contagion requiring their attention. The Commissioners answered the call, and pursued the course in relation to it, which is indicated above. After causing the owner of the herd a great deal of annoyance, injury to his business, pecuniary loss, and the removal of the one suspected cow, all restraint was removed, the usual business of the farm was resumed, and the commissioners have no knowledge that there has been any disease or suspicion of it on the premises for the last eleven months.

By the radical action of the board of health, the peculiar temperament and interests of the owner of the cattle, the sensational and overdrawn statements of newspaper correspondents and reporters, the Medford case was soon made famous; but, stripped of all extraneous matter and ill feeling, it was a very simple affair, and might have been easily disposed of with very little notoriety. Succinctly stated, it was as follows: Complaint was made to the board of health of the filthy and unhealthy condition of a certain stable and its surrounding grounds, and also of the herd of thirty-four cows kept therein, which were making milk for market. An examination by the board fully sustained the complaint. They at once ordered isolation, and put the premises in charge of a policeman, to prevent either cattle or milk from being removed, and notified the Cattle Commissioners. Our board answered the call, and made an examination of the stock. We found the animals had been abundantly fed, and most of them in good condition; a few new arrivals were thin in flesh, and four or five might fairly be suspected of infection with tuberculosis. The sanitary condition of the establishment was so bad that it was just to call it a nuisance. We pursued the same course as with the Waltham case, which we have previously indicated. If this establish-

ment was a nuisance, the board of health had power to abate it by cleaning it up, or removing it to a healthy locality. It was not done, however; the business of the owner was destroyed, restraint was finally removed, the concern broken up, and stock scattered by the act of the owner, and our board have not learned that it proved a new centre of tuberculous infection. The public discussion of these and other kindred cases convinced the Commissioners, that, notwithstanding our repeated publication of the characteristics and the facts in relation to the disease, the public were not fully informed respecting it, and boards of health were not aware of the direction and limitation of their powers and duties when taking control of a case. Therefore its secretary, by direction of the board, prepared the following circular, to which was appended our regulation for their guidance, and sent copies of the same to the proper officers of our cities and towns. The information it contained had also a wide circulation by aid of the newspaper press.

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## Tuberculosis: its Relations to Agricultural Industry and Public Health.

Secretary's Office, Dedham, Mass., May 1, 1890.

Tuberculosis is a word that is not found even in the latest editions of Webster's Unabridged Dictionary. The disease among animals known by this name is identical with that so long known as consumption in the human family; but that it is a contagious disease, which may be communicated from animals to man and from man to animals, has not been generally suspected even by the medical profession till within a comparatively recent period; and, now that its contagious nature is accepted, much further investigation is needed to determine exactly how and to what extent it is communicable under varying circumstances and conditions. Until very recently it was not believed that the milk from a tuberculous cow could be harmful, unless the disease had extended to the udder; but the experiments made during the past two years, under the auspices of the Massachusetts Society for Promoting Agriculture, have shown that the germs of the disease are some-

times found in milk drawn from presumably healthy udders. This renders the subject still more serious to consumers of milk. There is now no question but that the flesh or milk of a tuberculous cow, if taken without thorough cooking, may carry the disease to such as partake of it. The important questions are, What are the chances? and What can be done to avoid or lesson the danger?

The Cattle Commissioners during the past few years have received numerous notifications of suspected tuberculosis, and appeals for assistance in stamping out the disease from infected herds or localities; but thus far they have not seen their way clear for very vigorous action. The cattle disease law was enacted for the special purpose of stamping out contagious pleuro-pneumonia when it raged in Massachusetts thirty years ago. That is a disease that can be eradicated effectually only by the destruction of all infected animals, and also all healthy ones that may have been exposed to infection by coming within the presence of such as are diseased. Under these circumstances, animals in perfect health, to the value of many thousands of dollars, had to be killed and sold for beef; and, to partially indemnify cattle owners, it became necessary, in executing the law, to cause an appraisement of the animals, and the payment of their appraised value from the public treasury. Subsequently the Cattle Commissioners were given jurisdiction over cases of glanders in horses, and contagious diseases in any other domesticated animals; and for a number of years horses condemned for glanders were appraised and paid for at rates that not infrequently offered an inducement to horse owners to apply to State authorities for a market for such worthless stock. Although a later act discontinued the appraisal of glandered horses, the phraseology of the original statute was retained till the general revision of the law in 1887, when the Commissioners, *if in their judgment the circumstances of the case and the public good required it*, were given power to cause to be killed and buried any domestic animals which are infected with, or have been exposed to, a contagious disease; and, if they are satisfied that the disease has been contracted by intention or through negligence of owners or persons in their employ, or by feeding food liable to contain the germs of disease, it becomes the duty of the Commissioners to *destroy without an appraisal*. Exactly how the term "negligence" would be construed, or whether due care would mean the inspection by a competent veterinarian of every animal purchased in the open market, are questions that have not as yet been answered in our courts of justice.

But a careful study of the character of tuberculosis has con-

vinced the Commissioners, intelligent veterinarians and cattle men generally, that this is not a disease to be handled as contagious pleuro-pneumonia must be. It is usually slow and uncertain in its action, exceedingly difficult or impossible to detect in its early stages, and greatly modified in its course by conditions, sanitary or otherwise, under which the infected animals are kept.

The aim and purpose of the original statute was to suppress contagious pleuro-pneumonia, in the interest, primarily, of cattle owners, rather than for the protection of the public from the danger of consuming poisonous animal products.

The control of tuberculous cattle and their food products, when offered for public use, is as fully within the jurisdiction of boards of health and food inspectors as of the Cattle Commissioners, so long as action is restricted to the protection of human health; though any attempt to effectually eradicate the disease from the State might require the action of both.

Every wise person, before beginning any great work, will make as accurate an estimate as possible of the magnitude of the undertaking. The extent of the work required to clear an infected territory of tuberculosis will appear at least to those who have given the subject the least thought or consideration. In a State like Massachusetts, where a large proportion of the stock kept is shipped in from beyond her borders, there would be no end to the work till the outside territory was made free from the disease.

But there is another view of the subject, of which few even of the most vigilant veterinarians or medical men seem to have obtained so much as a glance; viz., the danger to healthy animals from association with consumptive members of the human family. Dr. Daniel D. Lee, instructor of anatomy in the veterinary department of Harvard University, contributed to the March number of the "Journal of Comparative Medicine and Veterinary Archives" a communication which touches this side of the question in a way that may well cause one to ask if the present need is not for a better understanding of the nature of the disease by all who produce or consume animal products, rather than for the pole-axe or shooting iron of the Cattle Commissioner. Under the title, "The Present Attitude of Veterinarians on the Subject of Tuberculosis," the doctor says: —

All the veterinarians who have had the advantage of a modern education in their profession are thoroughly convinced that tuberculosis is a contagious disease. They are aware that the disease can be produced by the inoculation of milk, of muscle juice or tuberculous products from animals suffering from the disease, and also that it is transmitted from

animal to animal and from man to animals by cohabitation and inhalation of dust containing dried sputa. Many veterinarians insist on the slaughter of all suspected animals, and at the same time forbid the use of their milk or meat for food.

Infection can undoubtedly be produced by *constantly* feeding animals with tuberculous milk or meat, but even so enthusiastic an authority as Professor Arloing acknowledges that this is the *least* important source of contagion. We certainly do not use such products constantly for our daily food, for the number of cattle found tuberculous averages about five in one thousand.

The chief source of danger, both for animals and men, lies in the inhalation of dust containing the dried sputa, in those localities where the disease is prevalent and the population dense. Cattle kept in such localities for milk, in badly ventilated barns, are diseased sometimes as high as forty per cent to fifty per cent, and are certainly as liable to contagion from tuberculous human beings as from one of their own kind. Under these circumstances, even if we kill off all the tuberculous animals, shall we have accomplished anything? Will not cows, pigs and chickens, coming in contact with tuberculous human beings, eating their sputa and breathing it in the form of dust, again contract the disease? Pet dogs and cats have done so. In my opinion, it is waste of time, and sometimes unjustifiable destruction of property, to kill off all our tuberculous animals, *unless* some means are adopted by the *medical profession* to quarantine their own patients.

In this part of the country people are beginning to have a horror of a tuberculous cow or pig, but feel not the slightest fear from direct contact with a person in an advanced stage of pulmonary tuberculosis, living in the same room, eating from the same dishes, and freely inhaling their dried sputa. Nor did I ever know a case where precautions were taken against the infection of cattle or other animals from tuberculous human beings. Now, as cattle are especially susceptible to tuberculosis, and as they have already greatly benefited the human race by furnishing it with the means of lessening the ravages of the small-pox, and as cattle are affected with tuberculosis in the largest percentage where they are kept for milk in localities where the percentage of the disease is also very great, I enter a plea that the severity of the crusade against them be somewhat lessened, until some steps are taken by the medical profession and boards of health to quarantine human beings suffering from tuberculosis.

I wish it understood that I believe tuberculosis to be a very contagious disease, but slow in its course. Every one will acknowledge that the danger from the milk and meat is the *very least*. The milk is diluted by that of healthy cows, under which circumstances even direct inoculation often fails; and the meat is only diseased in five cases in one thousand, and then is generally cooked. The danger from inhalation of dried sputa in the dust is very great either from man to man, or man to animals. Therefore, let us wait a little before we condemn all the cattle and other diseased animals; for, even if we eradicate the disease among them themselves, they will contract it again from man.

If these views and suggestions of Dr. Lee are worthy of consideration as a guide to action, it would be the height of absurdity to attempt to rid the State of tuberculous animals by taxing the people to pay for all that might be suspected of having the disease or of having been in some way exposed to it. If the disease, even now, were as prevalent as some have asserted, it would require millions of dollars to begin an undertaking which could give no promise of a satisfactory ending.

The Commissioners believe that the magnitude of the evil and the danger attending it cannot be too fully realized by cattle owners or consumers of cattle products, nor can the truth be known too soon. Tuberculosis does exist to a greater or less extent among the cattle of the State, and has existed among cattle herds for thousands of years. It can be kept in check or eradicated only by understanding and observing the influences which permit the continuance of its existence. This work, to be successful, should be entered upon by all. The Jews, who make the inspection of meats a religious duty, are nearly exempt from this disease. Boiled milk and thoroughly cooked meats are approximately free from the germs of any form of microscopic poison. If the tons of cheaper parts of beef which are daily sent to the fertilizer mills, because the American taste or fashion calls only for the choicer cuts for serving rare, were properly cooked, the people would save thousands of dollars on their meat bills, and at the same time escape a constant danger of contracting diseases through the consumption of uncooked flesh.

Many who have traced the connection between tuberculosis in cows and consumption in human beings have for years insisted that no uncooked milk shall be used upon their own tables. Boiling not only removes the danger of disease, but boiling and immediate cooling adds greatly to the keeping qualities, particularly in hot weather. There are said to be thirty different forms of bacterial life, not all harmful, found in milk; but cooking destroys all.

The course indicated for the safety of the farm herds is to secure a stock of healthy animals, and then breed a sufficient number of young to fully supply the home demand. A purchased creature coming from an unknown quarter always may be a source of danger. The oft-repeated story of those who find the disease in their herds is that "I bought a cow that was thin in flesh and looked badly, but I thought she would improve on my keeping. But, instead, she grew worse and died, and now some of my other cattle have that same bad look."

Never, on any consideration, breed from an animal of either sex

on which there is a shadow of suspicion as to health and vigor of constitution. Whether tuberculosis be directly hereditary, or not, a weak constitution most surely is, and such animals have little power to resist diseases if in any way they are exposed to them.

Feed generously, but do not pamper, nor confine animals in too close and ill-ventilated stables. The Commissioners find the most disease where the stables are narrow and tightly boarded up in front, so that the breath of any sick animal must be more or less mingled with that of all the others over and over again, with no sufficient inflow of fresh outside air.

Keep a sharp lookout for the earliest signs of disease, and, if possible, separate into a comfortable stall any animal that threatens danger to the herd. If an occasional animal must be purchased for breeding or other purposes, and its history is uncertain, keep it apart till its character for health is reasonably assured.

Allow no consumptive persons to have the care of herds of cattle, remembering that the expectorations from a diseased person, falling upon the food of animals, may become a boomerang that will hit back to the source from which it started.

By observing these rules constantly, the danger to the live stock interests of the State from contagious diseases will be reduced to the minimum, while the demand for healthful animal products will be greatly increased to the advantage of all.

A. W. CHEEVER,
*Secretary.*

BOSTON, May 12, 1890.

*To Boards of Health of Cities and Towns.*

In accordance with the spirit and intent of the foregoing paper, the undersigned issue the following regulation: In all cases of suspected tuberculosis among cattle coming to your notice, you will hereafter instruct owners to cause the separation of their suspected animals from the remainder of the herd, and cause their isolation, and allow the unsuspected animals to be managed in all respects as if no disease had been present.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
O. B. HADWEN,
*Cattle Commissioners of Massachusetts.*

It can but be noticed that the powers and duties of boards of health under existing law, and the requirements of our regulations, extend only to the control of the cattle supposed to be infected, and the abatement of a nuisance similar to the one mentioned at Medford. The sale of the milk and meat of such a herd is controlled by the provisions of chapter 58 of the Public Statutes, which, however, is not in force unless the city council or the inhabitants of the town vote to adopt the same. Most of our cities have complied with this requirement, but few, if any, of our towns. We therefore recommend that the following article be inserted in all the town warrants, to be acted on at their next town meeting; viz., to see if the town will vote to adopt the provisions of chapter 58 of the Public Statutes, enabling the selectmen to appoint an inspector of provisions and of animals intended for slaughter. This article being adopted, and an inspector appointed, legal control of the cattle and of the meat and milk will be secured, the former by the board of health, and the latter by the inspector; and the Commissioners will give active assistance to each of these classes of officers.

Early in December we received the following communication from Dr. Durgin, chairman of the Board of Health of Boston, transmitting a letter from Dr. Lyman, dean and professor of the Veterinary School of Harvard University, as follows: —

BOARD OF HEALTH, 12 BEACON STREET, BOSTON, Dec. 1, 1890.

*To the Honorable Cattle Commissioners.*

GENTLEMEN: — We have to-day received a letter from Dr. Lyman, dean and professor of the Harvard Veterinary School, upon the subject of increasing rabies among dogs, a copy of which we herewith enclose. Dr. Lyman is qualified to speak with authority upon this subject, and his letter is entitled to our serious attention. The order of the Honorable Cattle Commissioners, issued in February, 1888, requires the local boards of health, when notified of the existence of any contagious disease among domestic animals, to cause such animals to be securely isolated, and held till released by order of the Commissioners. With most of the diseases among domestic animals the execution of these orders would be sufficient; but with rabies we have a disease running so short a course, and attended by such serious consequences before the animal can be

restrained, that it would seem wise, if possible, to secure some previous action by which the liability to cases of rabies may be lessened, and their existence more readily detected. We are not quite certain that the desired action comes within the authority of the Cattle Commissioners; but whatever can be done should be done throughout the State, and, if not ordered, at least recommended, by the Commissioners.

If agreeable, this Board would respectfully request a conference at such time and place as may be determined by your Board.

The Board of Health,

SAMUEL H. DURGIN,
*Chairman.*

VETERINARY DEPARTMENT, HARVARD UNIVERSITY,
50 VILLAGE STREET, BOSTON, Dec. 1, 1890.

Dr. S. H. DURGIN, *Board of Health, City of Boston.*

DEAR SIR: — There is no doubt whatever that rabies has been existing in this community certainly since some time in February, 1888. During the whole of this period a large number of dogs have been brought to the veterinary hospital, that we have looked upon as showing the symptoms of rabies, and that have died rabid. The assertion that the dogs have died rabid is not made here upon the foundation of the symptoms shown and results of post-mortem examinations alone, but upon the additional fact that, in a number of the instances, carefully and thoroughly conducted laboratory work has proved its existence without doubt.

In connection with the existence of rabies among the dogs, and to some extent the other animals, there have been every now and then distressing occurrences among the people, coming from the bites of rabid animals, and ending too often in the death of the victim, accompanied always by a long-continued agonizing fear in the minds of the bitten ones and their families.

It seems to me that it is time that some properly organized effort to end this epizootic should be made. There is no doubt that the means of spread is very largely to be found in the existence with us of a class of semi-ownerless animals; for, if a dog that has rabies has also the interest and kindly care of his owner, he is seen to be ill before the dangerous period arrives, and so the chances of his being allowed to run "a muck" are reduced to almost nothing.

Perfect control of the spread of rabies is to be attained in our community only as a result of well-organized and carefully maintained State action. This action should take the form of com-

pulsory registration of all dogs, and the merciful destruction, after due care, of all dogs that remain unregistered. The proper muzzling of all dogs that go upon the streets would be an additional safeguard, but still is, in my opinion, unnecessary, if my first recommendation is properly carried out.

We already have in this State a most perfect *law* for compelling the registration of animals; and the dog tax could be made available for paying the expenses of catching the unregistered animals, supporting them for a proper time, and mercifully destroying those that remain unclaimed. We have also in the State Cattle Commissioners an organized body whose function it is to administer the laws regarding contagious disease among animals. No more distressing contagious disease of animals exists than rabies: why should not the Board act in this matter?

Yours very truly,

CHARLES P. LYMAN.

Though rabies has been a well-known, contagious disease from time immemorial, and its occurrence in this State has not been unknown, yet, from the roving, homeless, friendless character of the animal usually infected with and propagating it, until the present year we have never been notified of, and called by municipal officers to guard against, its spread. Five times since our last report was made we have been called to duty in this direction. These facts, and the above communication, caused us to fear that this most dreadful of all contagions is becoming more prevalent in the State; and by appointment we met the Board of Health of Boston for an examination and discussion of the whole subject, and, if possible, to determine in what line of effort we might hope to be most successful in diminishing its frequency. This conference led the Commissioners to believe that the public welfare required that an effort should be made to restrict the movement of ownerless, neglected or suspicious dogs. We therefore printed on one sheet, and sent to all our boards of health, all the regulations we had previously issued for their guidance in attempts to control animals infected with contagious disease, with an additional one, that the first four of the series must be made to apply to dogs. These regulations are inserted below.

STATE CATTLE COMMISSION,
SECRETARY'S OFFICE, DEDHAM, MASS., Jan. 3, 1891.

*To Boards of Health of Cities and Towns and Citizens of the Commonwealth.*

The Cattle Commissioners of Massachusetts, in conformity to the requirements of the Public Statutes, hereby make and publish the following rules and regulations for the suppression of contagious diseases among domestic animals: —

RULE 1. Whoever has knowledge of, or has good reason to suspect the existence of, a contagious disease among any species of domestic animals in this State, whether such knowledge or suspicion is obtained by personal examination or otherwise, shall forthwith give notice thereof to the board of health of the city or of the town where such diseased or suspected animals are kept.

RULE 2. The board of health of a city or of a town, having received notice of a suspected case of contagious disease among any of the domestic animals in their city or town, shall forthwith make an examination thereof personally, or by a competent person appointed by them for that purpose; and, if satisfied there are good reasons for believing that contagion is present, shall cause the suspected animals to be securely held by the owners or other reliable person, and shall immediately inform the Cattle Commissioners.

RULE 3. An order, written or verbal, to securely hold such suspected animals in isolation, shall be binding, whether given by a member of the board of health of the city or town, an authorized agent of such board, or by a single member of the Cattle Commission.

RULE 4. Persons having the care or custody of suspected animals, whether such animals are their own property or otherwise, and having received an order for their isolation, shall neither sell, swap, trade, give or in any way dispose of such animals, nor drive or work or move or allow them to be moved away from the place of isolation, nor allow other animals not already exposed to come in contact with them, till permitted so to do by the Cattle Commissioners.

## PLEURO-PNEUMONIA. HOG CHOLERA.

RULE 5. In cases of suspected contagious pleuro-pneumonia among cattle, or swine-plague or cholera among swine, the entire herd must be secured against communication with other animals of the same species that have not been exposed to the suspected animals; and owners of other herds which may have been exposed and afterwards moved should be immediately notified and warned of the existing danger.

### Glanders.

Rule 6. Horses or mules suspected of having the disease known as glanders or farcy may only remain in the custody of their owners, and in the stalls or on the premises previously occupied by them, when, in the judgment of boards of health, such owners can be relied on with confidence, and when such stalls or premises are deemed suitable places for holding such diseased or suspected animals till taken in charge by the Cattle Commissioners.

### Rabies or Hydrophobia.

Rabies or hydrophobia in dogs is evidently increasing in the community, particularly in thickly populated sections. Scientific investigation has removed much of the superstition formerly prevalent regarding this disease. It is now generally accepted by the well informed that rabies is a specific, contagious disease, due to the introduction into the system of the bacterial rabies germ from another animal suffering from the malady, and that its spread is in no way influenced by stars in the heavens or by "dog-days" weather, but is due to the bite of infected dogs or other animals, and which are as dangerous in cold weather as in the heat of midsummer. Municipal regulations for the restraint of this class of animals should, therefore, be no less operative at one season than at another.

The Cattle Commissioners, therefore, do hereby make and publish the following order, viz.: Rules 1, 2, 3 and 4 in this circular shall include dogs, and boards of health shall observe and publish said rules, and take the same course for the suppression of rabies as for the suppression of other contagious diseases among domestic animals, and shall cause all suspected dogs to be at once quarantined or securely held in restraint till destroyed or released by order of the Cattle Commissioners.

### Tuberculosis. Consumption.

During the past few years evidence has been accumulating which increases and strengthens the belief that consumption is a contagious disease common to both man and animals, and that its prevalence in the human family is, to a greater or less extent, due to the use of the milk or flesh of tuberculous cattle. With the unprecedented growth of cities following the improvements in steam transportation, the milk and meats consumed by the majority of the people must necessarily be produced so far from the tables of consumers as to give them no opportunity for personal inspection, or of knowing under what conditions these indispensable animal products may have been produced.

Under such conditions it is not a matter of surprise that intelligent city residents should demand that some safeguard be thrown around their food supply, and especially that some guarantee be given that the milk that they buy for their children shall not be loaded with the germs of some fatal disease.

The original statute for the suppression of contagious diseases among animals was enacted for the special purpose of stamping out contagious pleuro-pneumonia among cattle, — a disease that can only be effectually exterminated by killing not only all diseased animals, but also all that may have been exposed to the disease; and it was but simple justice, when the latter class were seized for destruction, that they should be paid for by the public at a fair rate.

Diseases like glanders in horses, cholera in swine and scab in sheep do not call for the killing of all exposed animals; and, as no animal suffering from a loathsome disease is salable for human food, it is obviously unwise and unjust to require the public to bear a loss for which individuals may be chiefly or wholly responsible Tuberculosis in cattle, like glanders in horses, is a disease to be treated by the "weeding-out" process; and, the sooner a suspected animal is removed from its fellows, the better for all concerned.

Rule 7. In accordance with the spirit and intent of the foregoing, in all cases of suspected tuberculosis among cattle, coming to your notice, you will hereafter instruct owners to cause the separation of their suspected animals from the remainder of the herd, and cause their isolation, and allow the unsuspected animals to be managed in all respects as if no disease had been present.

The intent of the statute under which the Cattle Commission was created was the suppression of contagious diseases in the interest of animal owners, rather than the protection of consumers against the use of unwholesome animal products. Chapter 58 of the Public Statutes provides specially for the appointment by the selectmen of towns and mayor and aldermen of cities of inspectors of provisions; but such inspectors cannot be legally appointed until the town or city accepts the provisions of said chapter.

An inspector of provisions has the power to enter any building or premises for the examination of all kinds of food offered or kept for sale; and, with the increasing interest and anxiety felt by the public as to the wholesomeness of the milk, meat and other foods purchased in open markets, the Cattle Commissioners feel justified in *urgently calling the attention of boards of health* to the matter, and *requesting them* — if it has not already been done —*to see that there is an article inserted in the warrant for the next*

*town meeting*, under which action can be taken that will enable the selectmen of all the towns in the Commonwealth to appoint inspectors of provisions as the statutes provide. The Cattle Commissioners will cheerfully co-operate with towns and cities in any reasonable attempt to suppress or curtail the sale of milk or meat from cattle suspected of being infected with tuberculosis; but they believe that the appointment of an inspector, either a member of the local board of health or some other suitable person, is the first necessary step to be taken in each city or town.

### Publishing Regulations.

The death of citizens of this State from the loathsome and fatal disease of glanders contracted from diseased horses carelessly or ignorantly handled or treated, or surreptitiously removed from isolation; the too general negligence of animal owners, veterinarians and others in giving notice of the suspected existence of contagious diseases; and the lax or indifferent action of municipal officers in taking possession or control of animals within their jurisdiction suspected of being infected with contagion, — make it imperative that we call the attention of all good citizens to the statutes provided for the suppression of contagion among domestic animals, and that boards of health in each of the cities and towns of the Commonwealth *publish and place upon their records* such regulations concerning the treatment of suspected cases of contagion among domestic animals as will enable the proper authorities to subject offenders to legal prosecution.

### Penalties.

The statutes provide that any person who fails to comply with a regulation made or order given by the Cattle Commissioners or boards of health, in the discharge of their duty, is punishable by a fine not exceeding five hundred dollars, or by imprisonment not exceeding one year; and any city or town whose officers refuse or neglect to carry into effect the provisions of chapter 252 of the Acts of 1887, relating to *the publication of regulations*, the isolation of suspected animals, and the carrying into effect of all proper orders from the Cattle Commissioners, shall forfeit a sum not exceeding five hundred dollars for each day's neglect.

Levi Stockbridge,
A. W. Cheever,
O. B. Hadwen,
*Cattle Commissioners of Massachusetts.*

From time to time for more than twenty years laws have been placed on our statute books with the intent of suppressing dogs in the interest of sheep husbandry; but they have accomplished little in the line of their intention. A licensed, collared dog, but unrestrained and roving at will, is a deadly enemy to our flocks, whether in fold or pasture, and is no less so to the human family, if infected with rabies. That danger can be abated in but one way; which is, to *confine the animal on the premises of its owner, or, when moving abroad, to compel the owner to keep it constantly under his control and surveillance;* and, if it escapes *therefrom and is running at large, to make it a subject for seizure and confinement by legalized officers.* We recommend such an enactment, believing that it would serve to protect our people and animals from a dread disease, as well as our flocks from their destructive attacks.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
O. B. HADWEN,
*Cattle Commissioners.*

BOSTON, Jan. 8, 1891.

# INDEX TO SECRETARY'S REPORT.

PUBLIC DOCUMENT. No. 33.

# EIGHTH ANNUAL REPORT

OF THE

# BOARD OF CONTROL

OF THE

# STATE AGRICULTURAL EXPERIMENT STATION

AMHERST, MASS.

1890.

BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1891.

MASSACHUSETTS STATE

# AGRICULTURAL EXPERIMENT STATION,

AMHERST, MASS.

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# STATION STAFF.

C. A. Goessmann, Ph.D., LL.D., *Director and Chemist*, . Amherst.
J. E. Humphrey, S.B., *Vegetable Physiologist (Mycologist)*, Amherst.

Assistants.

| | |
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| W. H. Beal, A.B., M.E., . . | *General and Analytical Chemistry.* |
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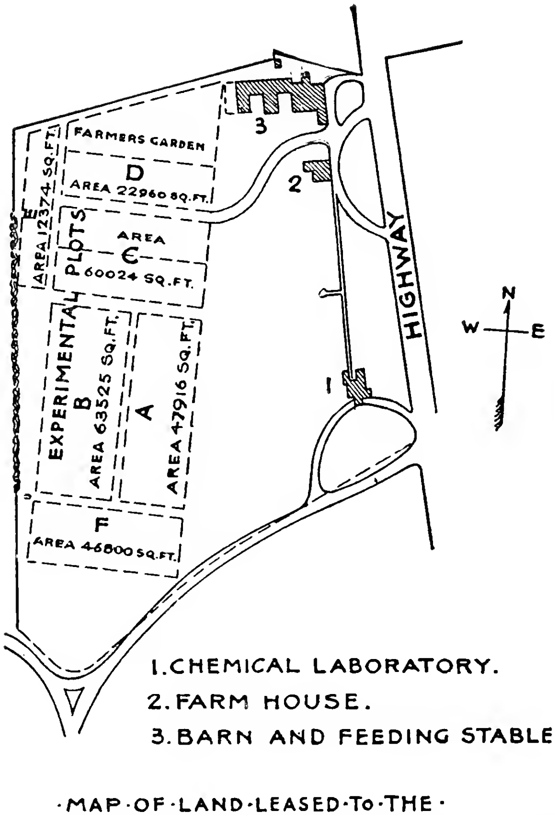
| C. S. Crocker, B.S., . . | " " " " |
| B. L. Hartwell, B.S., . . | " " " " |
| H. D. Haskins, B.S., . . | " " " " |
| C. H. Jones, B.S., . . . | " " " " |
| W. A. Parsons, B.S., . . | *Field Experiments and Stock Feeding.* |
| David Wentzell, . . . | *Farmer.* |

* Resigned July 1, 1890.

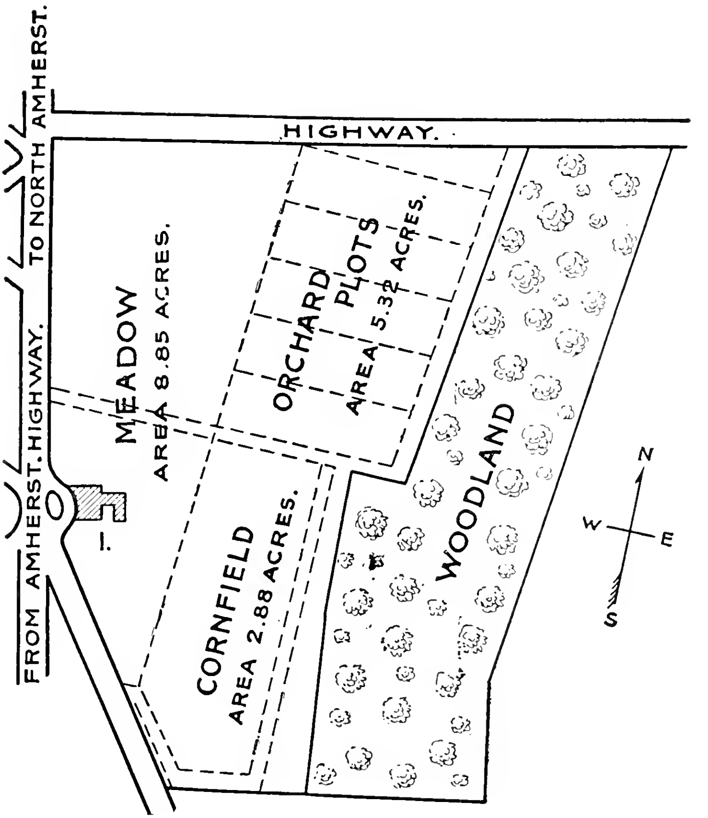



1. CHEMICAL LABORATORY.

2. FARM HOUSE.

3. BARN AND FEEDING STABLES.

·MAP·OF·LAND·LEASED·TO·THE·
·MASSACHUSETTS·EXPERIMENT·STATION·
·FROM·THE·
·AGRICULTURAL·COLLEGE·FARM·
·WEST·OF·THE·HIGHWAY·
·AREA·TAKEN··17.72·ACRES·




I. AGRICULTURAL & PHYSIOLOGICAL LABORATORY.

MAP·OF·LAND·LEASED·TO·THE
MASSACHUSETTS·EXPERIMENT·STATION
·FROM·THE·
AGRICULTURAL·COLLEGE·FARM
EAST·OF·THE·HIGHWAY
AREA·TAKEN·30.52·ACRES

Boston, Jan. 9, 1891.

*To the Honorable Senate and House of Representatives.*

In accordance with chapter 212 of the Acts of 1882 I have the honor to present the Eighth Annual Report of the Board of Control of the State Agricultural Experiment Station.

WM. R. SESSIONS,
*Secretary.*

# EIGHTH ANNUAL REPORT

OF THE

# DIRECTOR OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

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*To the Honorable Board of Control.*

GENTLEMEN: — The present condition of the State Agricultural Experiment Station may be considered a satisfactory one, as far as buildings and general outfit are concerned. The older buildings are in a good state of repair, and the new ones are well equipped for the purpose they are to serve.

The experimental work of the past year has been extensive, and in various directions. A favorable season has materially assisted in a successful termination of the work in the field.

No material changes have been made in regard to different lines of observation, decided upon at the beginning of the year. The details of the management have been carried out, as far as practicable, according to the plans from time to time presented for your consideration. Investigations in the laboratory, the vegetation house, the field and the barn, have received their due share of attention.

Professor Humphrey has continued his study of fungoidal diseases of plants, in various directions. A detailed description of his work in that connection forms a chapter in the annual report.

A series of field experiments, inaugurated at the close of the past season (1890), for the purpose of studying the effect of different forms of nitrogen and of phosphoric acid on the growth of winter rye and winter wheat, has been supplemented by control observations in pots in the vegetation house.

A number of reputed fodder crops, more or less new to the soil of Massachusetts, have been studied with regard to their adaptation to our climate and soil. Some of these have been raised in sufficient quantity to test their services as green fodder or hay for milk production.

Feeding experiments with milch cows with reference to an economical production of milk, and with young pigs for a remunerative production of pork, have been continued.

Considerable attention has been paid to the cost of the feed for the production of mutton and beef.

The work in the chemical laboratory has been, as usual, quite large, and for different purposes. The chemical analyses made at the station laboratory during the entire year, aside from four hundred analyses for the Hatch Station of the Agricultural College, number some nine hundred. Of these, from three hundred to four hundred were made at the special request of farmers in the State. They include analyses of fertilizers, fodder articles, well water, milk, etc.

The details of the work carried on in the directions previously stated are recorded in the subsequent pages of the annual report for 1890, under the following headings: —

### Feeding Experiments.

I. Two feeding experiments with milch cows.

1. Some general remarks on our previous feeding experiments with milch cows.
2. Feeding experiment with milch cows, to compare the value of old-process linseed meal with that of new-process linseed meal.
3. Feeding experiment with milch cows, to compare the economical value of reputed fodder crops, — vetch and oats, and soja bean, — when fed as green fodder in part or in whole for English hay.
4. Creamery record for 1889 and 1890.

II. Feeding experiments with lambs, to ascertain the cost of feed when fattening lambs, by means of winter fodder rations, for the meat market.

III. Feeding experiments with pigs, — skim-milk, corn meal, corn and cob meal, wheat bran and gluten meal, serving as fodder ingredients of the daily diet.

IV. Fodder analyses, 1890.

FIELD EXPERIMENTS.

V. Some suggestions regarding the question, How can we improve in an economical way the productiveness of our farm lands?

VI. Experiments to ascertain the effect of different combinations of nitrogen on oats.

VII. Field experiments with prominent grasses and leguminous plants, to study their composition and general economical value.

VIII. Field experiments with reputed field and garden crops, to ascertain their adaptation to our soil and climate.

IX. Field experiments to study the economy of using different commercial sources of phosphoric acid for manurial purposes in farm practice, — potatoes.

X. Experiments with grass land.

XI. Report on general farm work.

XII. Professor Humphrey's report.

SPECIAL WORK IN THE CHEMICAL LABORATORY.

XIII. Analyses of licensed commercial fertilizers.

XIV. Miscellaneous analyses of material sent on for examination.

XV. Water analyses.

XVI. Compilation of fodder analyses, with reference to fodder constituents and fertilizing constituents; analyses of industrial products, garden crops, fruits, etc., made at Amherst, Mass.

XVII. Meteorological observations.

The periodical publications of the station have been as numerous as in previous years. The circulation of bulletins and annual reports is steadily increasing.

In closing, it becomes a pleasing duty to acknowledge that the successful termination of the work carried on at the station during the past year is largely due to the industry and faithful execution of the various tasks assigned to all parties associated with me for that purpose.

With the assurance of my sincere thanks for your kind indulgence, permit me to sign,

Yours very respectfully,

C. A. GOESSMANN,

*Director of the Massachusetts Agricultural Experiment Station.*

AMHERST, MASS., Jan. 9, 1891.

# ON FEEDING EXPERIMENTS.
# 1890.

I. Two Feeding Experiments with Milch Cows.
II. One Feeding Experiment with Lambs.
III. Two Feeding Experiments with Pigs.
IV. Fodder Analyses.

## I.

1. Some general remarks on our previous feeding experiments with milch cows. 2. Feeding experiments with milch cows, to compare the value of old-process linseed meal with that of new-process linseed meal, when fed pound for pound under otherwise corresponding conditions. 3. Feeding experiments with milch cows, to compare the economical value of reputed fodder crops, — vetch and oats, and soja bean, — when fed as green fodder in part or in whole as substitutes for English hay. 4. Creamery record for 1889 and 1890.

### *1. Some General Remarks on our Previously Reported Feeding Experiments with Milch Cows.*

A careful examination of our last annual report cannot fail to show that our feeding experiments with milch cows, previous to the close of 1889, were chiefly instituted for the purpose of securing a satisfactory answer to the following questions: —

1. What is the comparative feeding effect of dry fodder corn, of dry corn stover, and of a good corn ensilage, when used in part or in the whole as a substitute for English hay (upland meadow hay), in the daily diet of milch cows, and also that of a good root crop in place of corn ensilage; the amount and kind of grain feed remaining, for obvious reasons, the same under otherwise corresponding circumstances?

2. What is the *total cost*, as well as the *net cost*, of the *daily feed* per head in case of the different fodder combinations used; making in all cases alike an allowance of a loss of twenty per cent. of the fertilizing constituents contained in the feed consumed, in consequence of the sale of the milk?

3. What is the commercial value, at current market rates, of the manurial refuse obtainable in the case of different fodder combinations used as daily diet for the support of cows, assuming that eighty per cent. of the value of the fertilizing constituents contained in the fodder consumed can be secured to the farm by a careful management?

The results of these experiments, which extend over a period of five successive years, 1885–89, were summed up in the following statements: —

1. The high nutritive value of fodder corn, corn stover and good corn ensilage, as compared with that of English hay, counting in all instances pound for pound of dry vegetable matter, is fully confirmed. The general condition of the animal on trial, as well as the quality and the quantity of the milk obtained, point in that direction.

2. To produce one quart of milk, using the same quantity and quality of grain feed, required in every instance a larger quantity of perfectly dried hay than of either fodder corn, corn stover or corn ensilage, in a corresponding state of dryness, — corn stover leading.

3. The net cost of feed in the case of the same ration of grain feed is from one-third to one-half less per quart of milk, when fodder corn, corn stover or corn ensilage serve as substitutes for English hay in the daily diet of milch cows; corn fodder, as a rule, leading, while corn stover leads the corn ensilage in four out of six cases.

4. Sugar beets, as well as carrots, when fed pound for pound of dry matter in place of part of the hay ration, with the same kind and quantity of grain feed, have raised almost without an exception the temporary yield of milk; exceeding, as a rule, the corn ensilage in that direction.

5. Corn ensilage, as well as roots, proved best when fed in place of one-fourth to one-half of the full hay ration. From twenty-five to twenty-seven pounds of roots, or from

thirty-five to forty pounds of corn ensilage per day, with all the hay called for to satisfy the animal in either case, seems, for various reasons, a good proportion, allowing the stated kind and quantity of grain feed.

6. The influence of the various diets used on the quality of the milk seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet. The increase in the quantity of milk is frequently accompanied by a decrease in solids.

The valuation of the fodder ingredients is based in this connection on the average of the local market price per ton of each article for the entire period of observation: —

| | | | |
|---|---|---|---|
| Corn meal, | $22 75 | Fodder corn, | $5 00 |
| Wheat bran, | 21 00 | Corn stover, | 5 00 |
| Gluten meal, | 24 50 | Corn ensilage, | 2 75 |
| Hay, | 15 00 | Carrots, | 7 00 |
| Rowen, | 15 00 | Sugar beets, | 5 00 |

The commercial valuation of the fertilizing constituents contained in each fodder article is based on the following market prices: *i. e.*, nitrogen (per pound), 17 cents; phosphoric acid, 6 cents; and potassium oxide, 4¼ cents. Eighty per cent. of the entire amount of fertilizing constituents contained in the fodder consumed is considered obtainable by proper management, while twenty per cent. is assumed to be sold with the milk.

For further details, see seventh annual report of station, pages 37–47, and 73–84.

It will be apparent, from the above statements, that it was the main aim of our feeding experiments with milch cows, during the years 1885–89, to compare the relative feeding value of our *current coarse fodder articles* with each other, — as, English hay, rowen, fodder corn, corn stover, corn ensilage and roots. To do this judiciously required in all cases the use of the same quantity and quality of grain feed. It is for this reason chiefly that the latter was confined to the same quantity of corn meal, corn and cob meal, wheat bran and gluten meal.

These articles were at any time at our disposal in our local market; all of them could claim a fair reputation for milk production.

During the past year *we have changed the object of our feeding experiments* with milch cows. Having made ourselves, as far as practicable, familiar with the feeding effect and general economical value of our current *coarse home-raised fodder articles*, it was decided to compare the feeding value of our prominent concentrated fodder articles (grains, brans, oilcakes, gluten meal, starch feed, etc.) with each other, under otherwise corresponding circumstances.

Some experiments with the two kinds of linseed meal (old and new process) are described within a few subsequent pages.

### 2. *Feeding Experiments with Milch Cows.*

Old-process linseed meal *vs.* new-process linseed meal, Dec. 11, 1889–July 2, 1890.

The feeding experiments subsequently described were instituted chiefly for the purpose of comparing the effect of new-process linseed meal with that of old-process linseed meal, on the *quantity* and *quality* of milk produced, and on *the cost of feed* consumed, when fed *in equal weights* as an ingredient of an otherwise corresponding daily diet of milch cows. This inquiry into the respective merits of both kinds of linseed meal for dairy purposes has been undertaken in response to frequent inquiries regarding that point on the part of dairymen in our State. The old-process linseed meal is sold, in our local markets, at $27 per ton of 2,000 pounds, and the new-process linseed meal of the Cleveland Linseed Oil Company at $26 for the same weight. The first-named article is obtained when the seed is subjected to the action of a powerful press to secure its oil; while the latter is produced by the aid of a new process, owned by the Cleveland company. The new process favors a more thorough abstraction of the oil, and involves, it is stated, a boiling of the seeds. The difference in the treatment of the seed, for the separation of the oil, explains one of the most characteristic differences in the composition of both kinds of linseed meal; for old-process linseed meal

contains, as a rule, a larger percentage of oil or fat, and a smaller one of organic-nitrogen-containing matter, than the new-process linseed meal. Aside from the stated causes of differences in their composition, there are various other circumstances which not unfrequently contribute towards serious variations in the composition of individual samples of both kinds. Among these is most prominent a more or less advanced state of maturity of the plant when harvested. Our inquiry into the comparative value of both kinds of meal as a fodder ingredient of the daily diet for milch cows has been carried on with articles of the following average composition: —

| COMPOSITION OF LINSEED MEAL USED. | New-process Linseed Meal. | Old-process Linseed Meal. |
|---|---|---|
| | Per Cent. | Per Cent. |
| Moisture at 100° C., | 5.06 | 9.88 |
| Dry matter, | 94.94 | 90.12 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 6.34 | 7.39 |
| " cellulose, | 8.93 | 8.74 |
| " fat, | 2.17 | 7.24 |
| " protein (nitrogenous matter), | 41.02 | 36.97 |
| Non-nitrogenous extract matter, | 41.54 | 39.66 |
| | 100.00 | 100.00 |

*Fertilizing Constituents.*

| | Per Cent. | Per Cent. |
|---|---|---|
| Moisture at 100° C., | 5.06 | 9.88 |
| Nitrogen, | 6.25 | 5.33 |
| Phosphoric acid, | 1.42 | 1.64 |
| Potassium oxide, | 1.16 | 1.16 |
| Valuation per ton of 2,000 pounds, | $24 00 | $21 50 |

Five cows, grades of various description, all of fair milking qualities, were selected for the trial. Two had dropped their last calves one month before the beginning of the observation, one five months, and two from eleven to twelve months. They differed but one year in their respective ages, which were from six to seven years.

English hay, rowen, fodder corn, corn stover, corn ensilage, carrots and sugar beets furnished at different times the main bulk of the daily fodder ration; while corn meal, wheat bran and both kinds of linseed meal alternately served as supplementary feed stuffs to secure a desired high nutritive character for the entire diet. The daily quantity of the grain feed, of roots and of hay, in case corn ensilage furnished largely the coarse feed, was in each case a definite one, decided upon before; it was in each case entirely consumed. The daily consumption of the coarse portion of the particular fodder combination on trial, as hay when fed alone, rowen, fodder corn, corn stover and corn ensilage, depended on the appetite of each individual animal. It varied usually somewhat in quantity in case of different cows. Care was taken to offer to each a liberal quantity. The unconsumed portion was weighed back each day, and subsequently accounted for in the daily feeding record.

The fodder corn, corn ensilage and corn stover were obtained from the same variety of corn, "Pride of the North," a dent corn. The ensilage corn and the fodder corn were of a corresponding stage of growth; *i.e.*, with kernel beginning to glaze. The corn stalks were in every case cut into pieces from one and one-half to two inches in length before being fed.

The entire experiment extended over six successive months, and was subdivided into nine distinct periods. The changes in daily diet were made gradually, as customary in well-conducted feeding experiments. The weekly weights of the animals on trial were taken on the same day, in the morning, before milking and feeding.

The adopted valuation of the different fodder articles is based on their local market price per ton of 2,000 pounds, at Amherst: —

| | |
|---|---|
| Corn meal, per ton, | $19 00 |
| Wheat bran, | 17 50 |
| Old-process linseed meal, | 27 00 |
| New-process linseed meal, | 26 00 |
| Carrots, | 7 00 |
| Sugar beets, | 5 00 |
| Hay, | 15 00 |
| Rowen, | 15 00 |
| Fodder corn, | 5 00 |
| Corn stover, | 5 00 |
| Corn ensilage, | 2 75 |

A few subsequent pages contain an abstract of the results of the experiment, closing with a detailed feeding record of every cow on trial: —

I. — *Statement of the Average of the Daily Fodder Combinations used during the Different Successive Feeding Periods.*

| I. | | II. | |
|---|---|---|---|
| Corn meal (pounds), | 3.25 | Corn meal (pounds), | 3.25 |
| Wheat bran, | 3.25 | Wheat bran, | 3.25 |
| Old-process linseed meal, | 3.25 | Old-process linseed meal, | 3.25 |
| Hay, | 18.50 | Hay, | 5.00 |
| Total cost (cents), | 24.18 | Corn ensilage, | 45.00 |
| Net cost, | 14.06 | Total cost (cents), | 20.25 |
| Manurial value obtainable, | 10.12 | Net cost, | 10.79 |
| Nutritive ratio, | 1 : 5.73 | Manurial value obtainable, | 9.46 |
| | | Nutritive ratio, | 1 : 6.27 |

| III. | | IV. | |
|---|---|---|---|
| Wheat bran (pounds), | 3.25 | Wheat bran (pounds), | 3.25 |
| Old-process linseed meal, | 3.25 | Old-process linseed meal, | 3.25 |
| Carrots, | 20.00 | Carrots, | 20.00 |
| Fodder corn, | 13.75 | Corn stover, | 16.00 |
| Total cost (cents), | 17 65 | Total cost (cents), | 18.21 |
| Net cost, | 9.58 | Net cost, | 9.20 |
| Manurial value obtainable, | 8.07 | Manurial value obtainable, | 9.01 |
| Nutritive ratio, | 1 : 5.16 | Nutritive ratio, | 1 : 5.15 |

I. — *Daily Fodder Combinations* — Concluded.

| V. | | VI. | |
|---|---|---|---|
| Wheat bran (pounds), | 3.25 | Corn meal (pounds), | 3.25 |
| New-process linseed meal, | 3.25 | Wheat bran, | 3.25 |
| Carrots, | 20.00 | New-process linseed meal, | 3.25 |
| Fodder corn, | 16.25 | Sugar beets, | 20.00 |
| Total cost (cents), | 18.06 | Hay, | 16.00 |
| Net cost, | 9.12 | Total cost (cents), | 27.16 |
| Manurial value obtainable, | 8.94 | Net cost, | 16.38 |
| Nutritive ratio, | 1 : 4.96 | Manurial value obtainable, | 10.78 |
| | | Nutritive ratio, | 1 : 5.23 |

| VII. | | VIII. | |
|---|---|---|---|
| Corn meal (pounds), | 3.25 | Corn meal (pounds), | 3.25 |
| Wheat bran, | 3.25 | Wheat bran, | 3.25 |
| Old-process linseed meal, | 3.25 | Old-process linseed meal, | 3.25 |
| Sugar beets, | 20.00 | Rowen, | 20.75 |
| Hay, | 16.00 | Total cost (cents), | 25.86 |
| Total cost (cents), | 27.30 | Net cost, | 13.48 |
| Net cost, | 16.96 | Manurial value obtainable, | 12.38 |
| Manurial value obtainable, | 10.34 | Nutritive ratio, | 1 : 5.04 |
| Nutritive ratio, | 1 : 5.63 | | |

| IX. | |
|---|---|
| Corn meal (pounds), | 3.25 |
| Wheat bran, | 3.25 |
| New-process linseed meal, | 3.25 |
| Rowen, | 20.75 |
| Total cost (cents), | 25.72 |
| Net cost, | 13.05 |
| Manurial value obtainable, | 12.67 |
| Nutritive ratio, | 1 : 4.73 |

II. — *Summary of the Cost of the Daily Fodder Rations (Cents).*

| | PERIODS. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
| Total cost, | 24.18 | 20.25 | 17.65 | 18.21 | 18.06 | 27.16 | 27.30 | 25.86 | 25.72 |
| Net cost, | 14.06 | 10.79 | 9.58 | 9.20 | 9.12 | 16.38 | 16.96 | 13.48 | 13.05 |
| Manurial value obtainable, | 10.12 | 9.46 | 8.07 | 9.01 | 8.94 | 10.78 | 10.34 | 12.38 | 12.67 |

## II. — *Daily Fodder Rations* — Concluded.

### *Valuation of Essential Fertilizing Constituents in the Various Fodder Articles used.*

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

| | Corn Meal. | Wheat Bran. | Old-process Oil Meal. | New-process Oil Meal. | Hay. | Corn Ensilage. | Fodder Corn. | Corn Stover. | Carrots. | Sugar Beets. | Rowen. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Moisture, | 11.67 | 9.27 | 9.88 | 5.06 | 9.72 | 72.95 | 20.42 | 22.50 | 90.47 | 90.02 | 13.53 |
| Nitrogen, | 1.479 | 2.545 | 5.331 | 6.254 | 1.379 | 0.33 | 1.058 | 1.211 | 0.149 | 0.184 | 1.790 |
| Phosphoric acid, | 0.713 | 2.900 | 1.646 | 1.420 | 0.359 | 0.138 | 0.510 | 0.303 | 0.100 | 0.086 | 0.464 |
| Potassium oxide, | 0.430 | 1.637 | 1.162 | 1.160 | 1.572 | 0.301 | 0.760 | 1.320 | 0.540 | 0.462 | 1.966 |
| Value per 2,000 lbs., | $6 27 | $13 60 | $21 15 | $24 00 | $6 53 | $1 56 | $4 89 | $5 67 | $1 12 | $1 14 | $8 42 |

## III. — *Amount of Dry Vegetable Matter of the Feed required to produce One Quart of Milk during the Experiment.*

| NAME. | Average Yield of Milk per Day (Quarts). | Average Amount of Dry Matter consumed to produce One Quart of Milk. |
|---|---|---|
| Juno, | 9.53 | 2.57 |
| Flora, | 7.46 | 3.17 |
| Jessie, | 7.40 | 3.09 |
| Roxy, | 12.55 | 1.99 |
| Pink, | 10.99 | 2.09 |

## IV. — *Cost of Feed consumed for the Production of One Quart of Milk during the Different Feeding Periods (Cents).*

| Feeding Periods, 1889-1890. | | Juno. | Flora. | Jessie. | Roxy. | Pink. |
|---|---|---|---|---|---|---|
| I. Dec. 11 to Dec. 31, | Total cost, | 2.54 | 2.88 | 3.08 | | |
| | Net cost, | 1.48 | 1.68 | 1.79 | | |
| | Obtainable manure, | 1.06 | 1.20 | 1.29 | | |
| II. Jan. 6 to Feb. 16, | Total cost, | 2.20 | 2.52 | 2.83 | | |
| | Net cost, | 1.17 | 1.34 | 1.51 | | |
| | Obtainable manure, | 1.03 | 1.18 | 1.32 | | |

IV. — *Cost of Feed, etc.* — Concluded.

| Feeding Periods, 1889-1890. | | Juno. | Flora | Jessie. | Roxy. | Pink. |
|---|---|---|---|---|---|---|
| III. Feb. 23 to March 13, | Total cost, | 2 19 | 3.00 | 2.85 | 1.37 | 1.61 |
| | Net cost, | 1.15 | 1 65 | 1.57 | .72 | .87 |
| | Obtainable manure, | 1.04 | 1.35 | 1.28 | 0.65 | 0.74 |
| IV. March 18 to April 5, | Total cost, | 2 24 | 2.81 | 2.72 | 1.63 | 1.76 |
| | Net cost, | 1.13 | 1.43 | 1.39 | .81 | .87 |
| | Obtainable manure, | 1.11 | 1.38 | 1.33 | 0.82 | 0.89 |
| V. April 9 to April 18, | Total cost, | 2.19 | 2.47 | 2.37 | 1.60 | 1.68 |
| | Net cost, | 1.11 | 1.25 | 1.21 | .79 | .85 |
| | Obtainable manure, | 1.08 | 1.22 | 1.16 | 0.81 | 0.83 |
| VI. April 25 to May 13, | Total cost, | 2.72 | 3.36 | 3.36 | 2.12 | 2.45 |
| | Net cost, | 1.64 | 2.02 | 2.02 | 1.60 | 1.48 |
| | Obtainable manure, | 1.08 | 1.34 | 1.34 | 0.52 | 0.97 |
| VII. May 18 to May 27, | Total cost, | 2 71 | 3.48 | 3.45 | 2.24 | 2 46 |
| | Net cost, | 1.69 | 2.16 | 2.14 | 1.39 | 1.53 |
| | Obtainable manure, | 1.02 | 1.32 | 1.31 | 0.85 | 0.93 |
| VIII. June 1 to June 19, | Total cost, | 2.38 | 3.19 | 3.10 | 2.10 | 2.17 |
| | Net cost, | 1.25 | 1.67 | 1.62 | 1.11 | 1.10 |
| | Obtainable manure, | 1.13 | 1.52 | 1.48 | 0.99 | 1.07 |
| IX. June 23 to July 2, | Total cost, | 2.49 | 3.59 | 3.09 | 2.12 | 2.24 |
| | Net cost, | 1.26 | 1 82 | 1.57 | 1.11 | 1.11 |
| | Obtainable manure, | 1.23 | 1.77 | 1.52 | 1.01 | 1.10 |

V. — *Average Quantity of Milk per Day (Quarts).*

| | Feeding Periods, 1889-1890. | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. |
| Juno, | 9.67 | 9.40 | 8.47 | 8.18 | 8.30 | 10.04 | 10.06 | 11.05 | 10.61 |
| Flora, | 8.64 | 8.41 | 5.73 | 6.45 | 7.26 | 7.86 | 7.64 | 7.89 | 7.29 |
| Jessie, | 7.87 | 7.16 | 6.05 | 6.57 | 7.44 | 7.75 | 7.48 | 8.19 | 8.09 |
| Roxy, | | | 13.52 | 11.46 | 11.64 | 13.18 | 12.67 | 12.84 | 12.22 |
| Pink, | | | 10.09 | 10.59 | 10.65 | 11.30 | 11.05 | 12.06 | 11.19 |

V. — *Average Quantity of Milk, etc.* — Concluded.

I. — Variations in daily production of milk during the entire feeding experiment (quarts).

II. — Average quantity of milk per day for the entire feeding experiment (quarts).

| | I. | II. |
|---|---|---|
| Juno, | 8.18 — 11.05 | 9.53 |
| Flora, | 5.73 — 8.64 | 7.46 |
| Jessie, | 6.05 — 8.19 | 7.40 |
| Roxy, | 11.46 — 13.52 | 12.55 |
| Pink, | 10.09 — 12.06 | 10.99 |

VI. — *Statement of the Average of Analyses of Milk made during the Different Feeding Periods.*

| Periods. | | Juno. | Flora. | Jessie. | Roxy. | Pink. |
|---|---|---|---|---|---|---|
| I., | Solids, per cent., | 12.84 | 13.47 | 14.72 | | |
| | Fat, per cent., | 3.89 | 3.72 | 5.21 | | |
| II., | Solids, per cent., | 12.97 | 13.86 | 14.93 | | |
| | Fat, per cent., | 3.93 | 4.33 | 5.86 | | |
| III., | Solids, per cent., | 13.68 | 15.44 | 15.61 | 13.27 | 14.86 |
| | Fat, per cent., | 4.33 | 6.00 | 6.45 | 4.21 | 5.73 |
| IV., | Solids, per cent., | 13.80 | 13.62 | 14.14 | 13.18 | 13.61 |
| | Fat, per cent., | 4.31 | 4.27 | 4.78 | 3.51 | 4.72 |
| V., | Solids, per cent., | 13.34 | 12.59 | 13.79 | 12.48 | 13.65 |
| | Fat, per cent., | 4.24 | 3.96 | 5.17 | 4.30 | 4.74 |
| VI., | Solids, per cent., | 14.37 | 13.30 | 14.93 | 13.21 | 14.45 |
| | Fat, per cent., | 4.76 | 3.71 | 5.57 | 3.91 | 5.02 |
| VII., | Solids, per cent., | 13.90 | 13.19 | 15.76 | 12.74 | 14.40 |
| | Fat, per cent., | 4.28 | 3.85 | 6.22 | 3.75 | 5.11 |
| VIII., | Solids, per cent., | 13.62 | 12.82 | 14.80 | 12.59 | 14.20 |
| | Fat, per cent., | 4.59 | 3.73 | 5.70 | 3.73 | 5.04 |
| IX., | Solids, per cent., | 13.85 | 12.93 | 14.43 | 12.81 | 14.40 |
| | Fat, per cent., | 4.45 | 3.52 | 5.13 | 3.68 | 3.93 |

VII. — *Creamery Record for the Different Feeding Periods.*

| Feeding Periods. | | Quarts of Milk set for Cream. | Spaces of Cream produced. | Average Number of Spaces per Day. | Quarts of Milk produced One Space of Cream. |
|---|---|---|---|---|---|
| | **1889-1890.** | | | | |
| I. | Dec. 11 to Dec. 31, . | 933.50 | 657 | 31.29 | 1.42 |
| II. | Jan. 6 to Feb. 16, . | 2,013.40 | 1,367 | 32.55 | 1.47 |
| III. | Feb. 23 to March 13, | 913.74 | 602 | 31.68 | 1.52 |
| IV. | March 18 to April 5, | 1,002.75 | 627 | 33.00 | 1.60 |
| V. | April 9 to April 18, . | 559.50 | 336 | 33.60 | 1.67 |
| VI. | April 25 to May 13, . | 1,159.50 | 665 | 35.00 | 1.74 |
| VII. | May 18 to May 27, . | 599.20 | 347 | 34.70 | 1.73 |
| VIII. | June 1 to June 19, . | 1,201.50 | 676 | 35.58 | 1.76 |
| IX. | June 23 to July 2, . | 601.25 | 333 | 33.30 | 1.81 |

VIII. — *Live Weights of Animals during the Feeding Periods (Pounds).*

| Name. | Feeding Periods. | | | | | | | | | Gain at Close. |
|---|---|---|---|---|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. | VI. | VII. | VIII. | IX. | |
| Juno, . . . . | 1,070 | 1,030 | 1,018 | 1,025 | 1,042 | 1,095 | 1,095 | 1,142 | 1,125 | 55 |
| Flora, . . . . | 1,000 | 990 | 960 | 984 | 1,005 | 1,047 | 1,050 | 1,084 | 1,080 | 80 |
| Jessie, . . . . | 888 | 870 | 827 | 830 | 838 | 901 | 897 | 932 | 928 | 40 |
| Roxy, . . . . | | | 834 | 849 | 864 | 898 | 915 | 955 | 938 | 104 |
| Pink, . . . . | | | 800 | 814 | 818 | 860 | 860 | 852 | 859 | 59 |

IX. — *Conclusion.*

An examination of the previously recorded results of the inquiry into the respective particular claims of both kinds of linseed meal as food constituents for dairy purposes shows that, *at stated market prices*, under *otherwise corresponding circumstances* and when *used in equal-weight parts*, they may serve in place of each other without materially affecting the financial side of the operation one way or the

other. In case the new-process linseed meal is used, the net cost of the milk is somewhat less, on account of the larger amount of fertilizing elements it contains, which increases somewhat the value of obtainable manure (see rations 6, 7, 8 and 9). This advantage is, however, in the majority of instances, to some extent compensated for by a somewhat more liberal yield of milk, in case old-process linseed meal has been fed. As the old-process linseed meal has a well-established reputation as a suitable food constituent for dairy cows, the new-process linseed meal may claim a similar position in the front rank of concentrated feed stuffs for dairy purposes. A careful selection of suitable associated fodder constituents is, however, in both instances, necessary to show their real economical value. A comparison of the yield of milk obtained, in the majority of cases, during feeding periods III., IV., with those of periods VI., VII., VIII. and IX., cannot fail to render that point prominent.

## X. — *Detailed Statement of the Feeding Record of the Different Cows on Trial.*

### 1. JUNO: *Age, seven years; grade, Ayrshire; last calf, June 22, 1889.*

| FEEDING PERIODS. | Corn Meal. | Wheat Bran. | Old-process Linseed Meal. | New-process Linseed Meal. | Hay. | Corn Ensilage. | Fodder Corn. | Corn Stover. | Carrots. | Sugar Beets. | Rowen. | Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds). | Quarts of Milk produced per Day. | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | FEED CONSUMED (POUNDS) PER DAY. | | | | | | | | | | | | | | | |
| **1889 - 1890.** | | | | | | | | | | | | | | | | |
| Dec. 11 to Dec. 31, | 3.25 | 3.25 | 3.25 | – | 18.95 | – | – | – | – | – | – | 25.84 | 9.67 | 2.67 | 1 : 5.76 | 1,070 |
| Jan. 6 to Feb. 16, | 3.25 | 3.25 | 3.25 | – | 5.00 | 47.81 | – | – | – | – | – | 26.17 | 9.40 | 2.78 | 1 : 6.36 | 1,030 |
| Feb. 23 to March 13, | – | 3.25 | 3.25 | – | – | – | 17.53 | – | 20.00 | – | – | 21.72 | 8.47 | 2.56 | 1 : 5.51 | 1,018 |
| March 18 to April 5, | – | 3.25 | 3.25 | – | – | – | – | 16.32 | 20.00 | – | – | 20.42 | 8.18 | 2.50 | 1 : 5.17 | 1,025 |
| April 9 to April 18, | – | 3.25 | – | 3.25 | – | – | 16.75 | – | 20.00 | – | – | 21.26 | 8.30 | 2.56 | 1 : 5.01 | 1,042 |
| April 25 to May 13, | 3.25 | 3.25 | – | 3.25 | 16.11 | – | – | – | – | 20.00 | – | 25.43 | 10.04 | 2.53 | 1 : 5.24 | 1,095 |
| May 18 to May 27, | 3.25 | 3.25 | 3.25 | – | 16.00 | – | – | – | – | 20.00 | – | 25.17 | 10.06 | 2.50 | 1 : 5.63 | 1,095 |
| June 1 to June 19, | 3.25 | 3.25 | 3.25 | – | – | – | – | – | – | – | 21.34 | 27.18 | 11.05 | 2.46 | 1 : 5.08 | 1,142 |
| June 23 to July 2. | 3.25 | 3.25 | – | 3.25 | – | – | – | – | – | – | 21.70 | 27.65 | 10.61 | 2.61 | 1 : 4.77 | 1,125 |
| **2. FLORA: *Age, six years; grade, Durham; last calf, Dec. 22, 1888.*** | | | | | | | | | | | | | | | | |
| Dec. 11 to Dec. 31, | 3.25 | 3.25 | 3.25 | – | 19.43 | – | – | – | – | – | – | 26.27 | 8.64 | 3.04 | 1 : 5.79 | 1,000 |
| Jan. 6 to Feb. 16, | 3.25 | 3.25 | 3.25 | – | 5.00 | 51.17 | – | – | – | – | – | 27.08 | 8.41 | 3.22 | 1 : 6.44 | 990 |
| Feb. 23 to March 13, | – | 3.25 | 3.25 | – | – | – | 11.95 | – | 20.00 | – | – | 17.28 | 5.73 | 3.02 | 1 : 4.96 | 960 |
| March 18 to April 5, | – | 3.25 | 3.25 | – | – | – | – | 15.74 | 20.00 | – | – | 19.97 | 6.45 | 3.09 | 1 : 5.13 | 984 |
| April 9 to April 18, | – | 3.25 | – | 3.25 | – | – | 15.70 | – | 20.00 | – | – | 20.42 | 7.26 | 2.81 | 1 : 4.91 | 1,005 |
| April 25 to May 13, | 3.25 | 3.25 | – | 3.25 | 15.00 | – | – | – | – | 20.00 | – | 24.43 | 7.86 | 3.11 | 1 : 5.16 | 1,047 |
| May 18 to May 27, | 3.25 | 3.25 | 3.25 | – | 15.00 | – | – | – | – | 20.00 | – | 24.27 | 7.64 | 3.18 | 1 : 5.55 | 1,050 |
| June 1 to June 19, | 3.25 | 3.25 | 3.25 | – | – | – | – | – | – | – | 19.79 | 25.84 | 7.89 | 3.28 | 1 : 5.01 | 1,084 |
| June 23 to July 2, | 3.25 | 3.25 | – | 3.25 | – | – | – | – | – | – | 21.40 | 27.39 | 7.29 | 3.76 | 1 : 4.75 | 1,080 |

## FEEDING RECORD — *Continued.*

### 3. Jessie: *Age, six years; grade, Jersey; last calf, Jan. 12, 1889.*

| Feeding Periods. | Feed consumed (Pounds) per Day. Corn Meal. | Wheat Bran. | Old-process Linseed Meal. | New-process Linseed Meal. | Hay. | Corn Ensilage. | Fodder Corn. | Corn Stover. | Carrots. | Sugar Beets. | Rowen. | Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds). | Quarts of Milk produced per Day. | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1889 - 1890.** | | | | | | | | | | | | | | | | |
| Dec. 11 to Dec. 31, | 3.25 | 3.25 | 3.25 | – | 18.43 | – | – | – | – | – | – | 25.37 | 7.87 | 3.22 | 1 : 5.72 | 888 |
| Jan. 6 to Feb. 16, | 3.25 | 3.25 | 3.25 | – | 5.00 | 45.02 | – | – | – | – | – | 25.42 | 7.16 | 3.55 | 1 : 6.27 | 870 |
| Feb. 23 to March 13, | – | 3.25 | 3.25 | – | – | – | 12.21 | – | 20.00 | – | – | 17.49 | 6.05 | 2.89 | 1 : 5.00 | 827 |
| March 18 to April 5, | – | 3.25 | 3.25 | – | – | – | – | 14.47 | 20.00 | – | – | 18.98 | 6.57 | 2.89 | 1 : 5.02 | 830 |
| April 9 to April 18, | – | 3.25 | – | 3.25 | – | – | 14.30 | – | 20.00 | – | – | 19.31 | 7.44 | 2.60 | 1 : 4.78 | 838 |
| April 25 to May 13, | 3.25 | 3.25 | – | 3.25 | 14.53 | – | – | – | – | 20.00 | – | 24.01 | 7.75 | 3.10 | 1 : 5.12 | 901 |
| May 18 to May 27, | 3.25 | 3.25 | 3.25 | – | 14.00 | – | – | – | – | 20.00 | – | 23.37 | 7.48 | 3.12 | 1 : 5.47 | 897 |
| June 1 to June 19, | 3.25 | 3.25 | 3.25 | – | – | – | – | – | – | – | 20.16 | 26.16 | 8.19 | 3.19 | 1 : 5.02 | 932 |
| June 23 to July 2, | 3.25 | 3.25 | – | 3.25 | – | – | – | – | – | – | 19.90 | 26.09 | 8.09 | 3.22 | 1 : 4.69 | 928 |

### 4. Roxy: *Age, seven years; grade, Ayrshire; last calf, Feb. 5, 1890.*

| Feeding Periods. | Corn Meal. | Wheat Bran. | Old-process Linseed Meal. | New-process Linseed Meal. | Hay. | Corn Ensilage. | Fodder Corn. | Corn Stover. | Carrots. | Sugar Beets. | Rowen. | Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds). | Quarts of Milk produced per Day. | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb. 23 to March 13, | – | 3.25 | 3.25 | – | – | – | 17.21 | – | 20.00 | – | – | 21.47 | 13.52 | 1.59 | 1 : 5.48 | 834 |
| March 18 to April 5, | – | 3.25 | 3.25 | – | – | – | – | 18.11 | 20.00 | – | – | 21.81 | 11.46 | 1.90 | 1 : 5.30 | 849 |
| April 9 to April 18, | – | 3.25 | – | 3.25 | – | – | 18.30 | – | 20.00 | – | – | 22.49 | 11.64 | 1.93 | 1 : 5.15 | 864 |
| April 25 to May 13, | 3.25 | 3.25 | – | 3.25 | 17.05 | – | – | – | – | 20.00 | – | 26.28 | 13.18 | 1.99 | 1 : 5.31 | 898 |
| May 18 to May 27, | 3.25 | 3.25 | 3.25 | – | 17.40 | – | – | – | – | 20.00 | – | 26.44 | 12.67 | 2.09 | 1 : 5.73 | 915 |
| June 1 to June 19, | 3.25 | 3.25 | 3.25 | – | – | – | – | – | – | – | 22.16 | 27.89 | 12.84 | 2.17 | 1 : 5.11 | 955 |
| June 23 to July 2, | 3.25 | 3.25 | – | 3.25 | – | – | – | – | – | – | 21.90 | 27.83 | 12.22 | 2.28 | 1 : 4.81 | 938 |

## FEEDING RECORD — *Concluded.*

5. PINK : *Age, six years; native; last calf, Jan. 23, 1890.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. Corn Meal. | Wheat Bran. | Old-process Linseed Meal. | New-process Linseed Meal. | Hay. | Corn Ensilage. | Fodder Corn. | Corn Stover. | Carrots. | Sugar Beets. | Rowen. | Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds). | Quarts of Milk produced per Day. | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1890.** | | | | | | | | | | | | | | | | |
| Feb. 23 to March 13, | – | 3.25 | 3.25 | – | – | – | 11.05 | – | 17.90 | – | – | 16.36 | 10.09 | 1.62 | 1 : 4.87 | 800 |
| March 18 to April 5, | – | 3.25 | 3.25 | – | – | – | – | 17.74 | 20.00 | – | – | 21.52 | 10.59 | 2.03 | 1 : 5.27 | 814 |
| April 9 to April 18, | – | 3.25 | – | 3.25 | – | – | 15.60 | – | 20.00 | – | – | 20.34 | 10.65 | 1.91 | 1 : 4.90 | 818 |
| April 25 to May 13, | 3.25 | 3.25 | – | 3.25 | 16.79 | – | – | – | – | 20.00 | – | 26.05 | 11.30 | 2.31 | 1 : 5.29 | 860 |
| May 18 to May 27, | 3.25 | 3.25 | 3.25 | – | 15.80 | – | – | – | – | 20.00 | – | 24.99 | 11.05 | 2.26 | 1 : 5.61 | 860 |
| June 1 to June 19, | 3.25 | 3.25 | 3.25 | – | – | – | – | – | – | – | 20.37 | 26.34 | 12.06 | 2.18 | 1 : 5.02 | 852 |
| June 23 to July 2, | 3.25 | 3.25 | – | 3.25 | – | – | – | – | – | – | 20.00 | 26.18 | 11.19 | 2.34 | 1 : 4.69 | 859 |

6. NANCY : *Age, seven years; native; last calf, March 16, 1890.*

| FEEDING PERIODS. | Corn Meal. | Wheat Bran. | Old-process Linseed Meal. | New-process Linseed Meal. | Hay. | Corn Ensilage. | Fodder Corn. | Corn Stover. | Carrots. | Sugar Beets. | Rowen. | Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds). | Quarts of Milk produced per Day. | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| March 25 to April 5, | – | 3.25 | 3.25 | – | – | – | – | 13.50 | 20.00 | – | – | 18.23 | 12.70 | 1.44 | 1 : 4.94 | 860 |
| May 18 to May 27, | 3.25 | 3.25 | 3.25 | – | 15.80 | – | – | – | – | 20.00 | – | 24.99 | 13.02 | 1.92 | 1 : 5.61 | 875 |
| June 1 to June 19, | 3.25 | 3.25 | 3.25 | – | – | – | – | – | – | – | 19.76 | 25.82 | 13.21 | 1.95 | 1 : 5.01 | 900 |
| June 23 to July 2, | 3.25 | 3.25 | – | 3.25 | – | – | – | – | – | – | 19.70 | 25.93 | 12.74 | 2.04 | 1 : 4.67 | 889 |

## Total Cost of Feed per Quart of Milk.

### 1. *Juno.*

| Feeding Periods. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Old-process Linseed Meal consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Fodder Corn consumed (Pounds). | Total Amount of Corn Stover consumed (Pounds). | Total Amount of Carrots consumed (Pounds). | Total Amount of Sugar Beets consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | | | | | | | | |
| Dec. 11 to Dec. 31, | 203.02 | 9.67 | 68.25 | 68.25 | 68.25 | – | 398.00 | – | – | – | – | – | – | $5 16 | 2.54 |
| Jan. 6 to Feb. 16, | 394.88 | 9.40 | 136.50 | 136.50 | 136.50 | – | 210.00 | 2,008.00 | – | – | – | – | – | 8 68 | 2 20 |
| Feb. 23 to March 13, | 160.93 | 8.47 | – | 61.75 | 61.75 | – | – | – | 333.00 | – | 380.00 | – | – | 3 53 | 2.19 |
| March 18 to April 5, | 155.35 | 8.18 | – | 61.75 | 61.75 | – | – | – | – | 310.00 | 380.00 | – | – | 3 48 | 2.24 |
| April 9 to April 18, | 83.02 | 8.30 | – | 32.50 | – | 32.50 | – | – | 167.50 | – | 200.00 | – | – | 1 82 | 2.19 |
| April 25 to May 13, | 190.70 | 10.04 | 61.75 | 61.75 | – | 61.75 | 306.00 | – | – | – | – | 380.00 | – | 5 18 | 2 72 |
| May 18 to May 27, | 100.58 | 10.06 | 32.50 | 32.50 | 32.50 | – | 160.00 | – | – | – | – | 200.00 | – | 2 73 | 2.71 |
| June 1 to June 19, | 209.88 | 11.05 | 61.75 | 61.75 | 61.75 | – | – | – | – | – | – | – | 405.50 | 5 00 | 2.38 |
| June 23 to July 2, | 106.05 | 10.61 | 32.50 | 32.50 | – | 32.50 | – | – | – | – | – | – | 217.00 | 2 64 | 2.49 |

Total Cost of Feed per Quart of Milk — *Continued.*

2. *Flora.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Old-process Linseed Meal consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Fodder Corn consumed (Pounds). | Total Amount of Corn Stover consumed (Pounds). | Total Amount of Carrots consumed (Pounds). | Total Amount of Sugar Beets consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | | | | | | | | |
| Dec. 11 to Dec. 31, | 181.50 | 8 64 | 68 25 | 68.25 | 68.25 | – | 408.00 | – | – | – | – | – | – | $5 23 | 2.88 |
| Jan. 6 to Feb. 16, | 353.02 | 8.41 | 136.50 | 136.50 | 136.50 | – | 210.00 | 2,149.00 | – | – | – | – | – | 8 88 | 2.52 |
| Feb. 23 to March 13, | 108.84 | 5.73 | – | 61.75 | 61.75 | – | – | – | 227.00 | – | 380.00 | – | – | 3 27 | 3 00 |
| March 18 to April 5, | 122 56 | 6.45 | – | 61.75 | 61.75 | – | – | – | – | 299 00 | 380.00 | – | – | 3 45 | 2.81 |
| April 9 to April 18, | 72.56 | 7.26 | – | 32 50 | – | 32.50 | – | – | 157.00 | – | 200.00 | – | – | 1 79 | 2.47 |
| April 25 to May 13, | 149 32 | 7.86 | 61.75 | 61.75 | – | 61.75 | 285.00 | – | – | – | – | 380.00 | – | 5 02 | 3.36 |
| May 18 to May 27, | 76.40 | 7.64 | 32.50 | 32 50 | 32.50 | – | 150.00 | – | – | – | – | 200.00 | – | 2 66 | 3 48 |
| June 1 to June 19, | 150.00 | 7 89 | 61.75 | 61.75 | 61.75 | – | – | – | – | – | – | – | 376.00 | 4 78 | 3.19 |
| June 23 to July 2, | 72.91 | 7.29 | 32.50 | 32 50 | – | 32.50 | – | – | – | – | – | – | 214.00 | 2 62 | 3.59 |

TOTAL COST OF FEED PER QUART OF MILK — *Continued.*

3. *Jessie.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Old-process Linseed Meal consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Fodder Corn consumed (Pounds). | Total Amount of Corn Stover consumed (Pounds). | Total Amount of Carrots consumed (Pounds). | Total Amount of Sugar Beets consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | | | | | | | | |
| Dec. 11 to Dec. 31, | 165.25 | 7.87 | 68.25 | 68.25 | 68.25 | – | 387.00 | – | – | – | – | – | – | $5 07 | 3.08 |
| Jan. 6 to Feb. 16, | 300.70 | 7 16 | 136.50 | 136.50 | 136.50 | – | 210.00 | 1,891.00 | – | – | – | – | – | 8 52 | 2.83 |
| Feb. 23 to March 13, | 115.00 | 6 05 | – | 61.75 | 61.75 | – | – | – | 232.00 | – | 380.00 | – | – | 3 28 | 2.85 |
| March 18 to April 5, | 124.75 | 6.57 | – | 61.75 | 61.75 | – | – | – | – | 275.00 | 380.00 | – | – | 3 39 | 2.72 |
| April 9 to April 18, | 74.40 | 7.44 | – | 32.50 | – | 32.50 | – | – | 143.00 | – | 200.00 | – | – | 1 76 | 2.37 |
| April 25 to May 13, | 147.25 | 7.75 | 61.75 | 61.75 | – | 61.75 | 276.00 | – | – | – | – | 380.00 | – | 4 95 | 3.36 |
| May 18 to May 27, | 74.77 | 7.48 | 32.50 | 32.50 | 32.50 | – | 140 00 | – | – | – | – | 200.00 | – | 2 58 | 3.45 |
| June 1 to June 19, | 155.70 | 8.19 | 61.75 | 61.75 | 61.75 | – | – | – | – | – | – | – | 383.00 | 4 83 | 3.10 |
| June 23 to July 2, | 80.93 | 8.09 | 32.50 | 32.50 | – | 32.50 | – | – | – | – | – | – | 199.00 | 2 50 | 3.09 |

4. *Roxy.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Old-process Linseed Meal consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Fodder Corn consumed (Pounds). | Total Amount of Corn Stover consumed (Pounds). | Total Amount of Carrots consumed (Pounds). | Total Amount of Sugar Beets consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Feb. 23 to March 13, | 256.86 | 13.52 | – | 61.75 | 61.75 | – | – | – | 327.00 | – | 380.00 | – | – | $3 52 | 1.37 |
| March 18 to April 5, | 217.75 | 11.46 | – | 61.75 | 61.75 | – | – | – | – | 344.00 | 380.00 | – | – | 3 56 | 1.63 |
| April 9 to April 18, | 116.40 | 11.64 | – | 32 50 | – | 32.50 | – | – | 183.00 | – | 200.00 | – | – | 1 86 | 1.60 |
| April 25 to May 13, | 250.35 | 13.18 | 61.75 | 61.75 | – | 61.75 | 324.00 | – | – | – | – | 380.00 | – | 5 31 | 2.12 |
| May 18 to May 27, | 126.74 | 12.67 | 32.50 | 32 50 | 32.50 | – | 174.00 | – | – | – | – | 200.00 | – | 2 84 | 2 24 |
| June 1 to June 19, | 243.95 | 12.84 | 61.75 | 61.75 | 61.75 | – | – | – | – | – | – | – | 421.00 | 5 12 | 2.10 |
| June 23 to July 2, | 122.21 | 12.22 | 32.50 | 32.50 | – | 32.50 | – | – | – | – | – | – | 219.00 | 2 65 | 2.17 |

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

*5. Pink.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Old-process Linseed Meal consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Fodder Corn consumed (Pounds). | Total Amount of Corn Stover consumed (Pounds). | Total Amount of Carrots consumed (Pounds). | Total Amount of Sugar Beets consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **1890.** | | | | | | | | | | | | | | | |
| Feb. 23 to March 13, | 191.74 | 10.09 | – | 61.75 | 61.75 | – | – | – | 210.00 | – | 340.00 | – | – | $3 09 | 1 61 |
| March 18 to April 5, | 201.16 | 10.59 | – | 61.75 | 61.75 | – | – | – | – | 337.00 | 380.00 | – | – | 3 54 | 1.76 |
| April 9 to April 18, | 106 51 | 10 65 | – | 32.50 | – | 32 50 | – | – | 156.00 | – | 200.00 | – | – | 1 79 | 1 68 |
| April 25 to May 13, | 214.75 | 11.30 | 61.75 | 61.75 | – | 61.75 | 319.00 | – | – | – | – | 380.00 | – | 5 27 | 2.45 |
| May 18 to May 27, | 110.47 | 11.05 | 32 50 | 32.50 | 32.50 | – | 158.00 | – | – | – | – | 200.00 | – | 2 72 | 2.46 |
| June 1 to June 19, | 229.07 | 12 06 | 61.75 | 61.75 | 61.75 | – | – | – | – | – | – | – | 387.00 | 4 86 | 2.12 |
| June 23 to July 2, | 111.86 | 11.19 | 32.50 | 32.50 | – | 32.50 | – | – | – | – | – | – | 200.00 | 2 51 | 2 24 |

*6. Nancy.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Old-process Linseed Meal consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Fodder Corn consumed (Pounds). | Total Amount of Corn Stover consumed (Pounds). | Total Amount of Carrots consumed (Pounds). | Total Amount of Sugar Beets consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| March 25 to April 5, | 152.44 | 12.70 | – | 39.00 | 39.00 | – | – | – | – | 162.00 | 240.00 | – | – | $2 12 | 1.39 |
| May 18 to May 27, | 130.23 | 13.02 | 32.50 | 32.50 | 32.50 | – | 158.00 | – | – | – | – | 200.00 | – | 2 72 | 2.09 |
| June 1 to June 19, | 250.93 | 13.21 | 61.75 | 61 75 | 61.75 | – | – | – | – | – | – | – | 375.50 | 4 78 | 1.90 |
| June 23 to July 2, | 127.35 | 12.74 | 32.50 | 32.50 | – | 32.50 | – | – | – | – | – | – | 197.00 | 2 49 | 1.96 |

## Net Cost of Milk and Manurial Value of Feed.

### 1. *Juno.*

| Feeding Periods. | Total Cost of Feed consumed during Period. | Value of Fertilizing Constituents contained in the Feed. | Manurial Value of the Feed after deducting the Twenty Per Cent. taken by the Milk. | Net Cost of Feed for the Production of Milk. | Net Cost of Feed for the Production of One Quart of Milk. | Weight of Animal at Close of Period. |
|---|---|---|---|---|---|---|
| **1889 - 1890.** | | | | | Cents. | Pounds. |
| Dec. 11 to Dec. 31, . | $5 16 | $2 69 | $2 15 | $3 01 | 1.48 | 1,034 |
| Jan. 6 to Feb. 16, . | 8 68 | 5 06 | 4 05 | 4 63 | 1.17 | 1,045 |
| Feb. 23 to Mar. 13, . | 3 53 | 2 10 | 1 68 | 1 85 | 1.15 | 1,030 |
| Mar. 18 to Apr. 5, . | 3 48 | 2 16 | 1 73 | 1 75 | 1.13 | 1,034 |
| Apr. 9 to Apr. 18, . | 1 82 | 1 13 | 90 | 92 | 1.11 | 1,071 |
| Apr. 25 to May 13, . | 5 18 | 2 57 | 2 06 | 3 12 | 1.64 | 1,115 |
| May 18 to May 27, . | 2 73 | 1 29 | 1 03 | 1 70 | 1.69 | 1,095 |
| June 1 to June 19, . | 5 00 | 2 97 | 2 38 | 2 62 | 1.25 | 1,145 |
| June 23 to July 2, . | 2 64 | 1 62 | 1 30 | 1 31 | 1.26 | 1,130 |
| Total, . . | $38 22 | $21 59 | $17 28 | $20 94 | – | – |

### 2. *Flora.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Dec. 11 to Dec. 31, . | $5 23 | $2 72 | $2 18 | $3 05 | 1.68 | 1,015 |
| Jan. 6 to Feb. 16, . | 8 88 | 5 17 | 4 14 | 4 74 | 1.34 | 1,004 |
| Feb. 23 to Mar. 13, . | 3 27 | 1 84 | 1 47 | 1 80 | 1.65 | 960 |
| Mar. 18 to Apr. 5, . | 3 45 | 2 13 | 1 70 | 1 75 | 1.43 | 980 |
| Apr. 9 to Apr. 18, . | 1 79 | 1 10 | 88 | 91 | 1.25 | 1,030 |
| Apr. 25 to May 13, . | 5 02 | 2 50 | 2 00 | 3 02 | 2.02 | 1,050 |
| May 18 to May 27, . | 2 66 | 1 26 | 1 01 | 1 65 | 2.16 | 1,065 |
| June 1 to June 19, . | 4 78 | 2 84 | 2 27 | 2 51 | 1.67 | 1,088 |
| June 23 to July 2, . | 2 62 | 1 61 | 1 29 | 1 33 | 1.82 | 1,085 |
| Total, . . | $37 70 | $21 17 | $16 94 | $20 76 | – | – |

### 3. *Jessie.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Dec. 11 to Dec. 31, . | $5 07 | $2 65 | $2 12 | $2 95 | 1.79 | 875 |
| Jan. 6 to Feb. 16, . | 8 52 | 4 96 | 3 97 | 4 55 | 1.51 | 865 |
| Feb. 23 to Mar. 13, . | 3 28 | 1 85 | 1 48 | 1 80 | 1.57 | 850 |
| Mar. 18 to Apr. 5, . | 3 39 | 2 06 | 1 65 | 1 74 | 1.39 | 820 |
| Apr. 9 to Apr. 18, . | 1 76 | 1 07 | 86 | 90 | 1.21 | 870 |
| Apr. 25 to May 13, . | 4 95 | 2 47 | 1 98 | 2 97 | 2.02 | 913 |
| May 18 to May 27, . | 2 58 | 1 23 | 98 | 1 60 | 2.14 | 910 |
| June 1 to June 19, . | 4 83 | 2 87 | 2 30 | 2 53 | 1.62 | 940 |
| June 23 to July 2, . | 2 50 | 1 54 | 1 23 | 1 27 | 1.57 | 935 |
| Total, . . | $36 88 | $20 70 | $16 57 | $20 31 | – | – |

Net Cost of Milk and Manurial Value of Feed — *Concluded.*

4. *Roxy.*

| FEEDING PERIODS. | Total Cost of Feed consumed during Period. | Value of Fertilizing Constituents contained in the Feed. | Manurial Value of the Feed after deducting the Twenty Per Cent taken by the Milk. | Net Cost of Feed for the Production of Milk. | Net Cost of Feed for the Production of One Quart of Milk. | Weight of Animal at Close of Period. |
|---|---|---|---|---|---|---|
| **1890.** | | | | | Cents. | Pounds. |
| Feb. 23 to Mar. 13, . | $3 52 | $2 08 | $1 66 | $1 86 | .72 | *840 |
| Mar 18 to Apr. 5, . | 3 56 | 2 25 | 1 80 | 1 76 | .81 | 853 |
| Apr. 9 to Apr 18, . | 1 86 | 1 17 | 94 | 92 | .79 | 875 |
| Apr. 25 to May 13, . | 5 31 | 1 63 | 1 30 | 4 01 | 1.60 | 906 |
| May 18 to May 27, | 2 84 | 1 34 | 1 07 | 1 77 | 1.39 | 925 |
| June 1 to June 19, . | 5 12 | 3 03 | 2 42 | 2 70 | 1.11 | 958 |
| June 23 to July 2, . | 2 65 | 1 63 | 1 30 | 1 35 | 1.10 | 940 |
| Total, . . | $24 86 | $13 13 | $10 49 | $14 37 | – | – |

5. *Pink.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Feb. 23 to Mar. 13, . | $3 09 | $1 77 | $1 42 | $1 67 | 0.87 | 773 |
| Mar. 18 to Apr. 5, . | 3 54 | 2 23 | 1 78 | 1 76 | 0.87 | 820 |
| Apr. 9 to Apr. 18, . | 1 79 | 1 10 | 88 | 91 | 0.85 | 825 |
| Apr. 25 to May 13, . | 5 27 | 2 61 | 2 09 | 3 18 | 1.48 | 878 |
| May 18 to May 27, . | 2 72 | 1 29 | 1 03 | 1 69 | 1.53 | 862 |
| June 1 to June 19, . | 4 86 | 2 89 | 2 31 | 2 55 | 1.11 | 855 |
| June 23 to July 2, . | 2 51 | 1 55 | 1 24 | 1 27 | 1.11 | 859 |
| Total, . . | $23 78 | $13 44 | $10 75 | $13 03 | – | – |

6. *Nancy.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Mar. 25 to Apr. 5, . | $2 12 | $1 27 | $1 02 | $1 10 | 0.72 | 840 |
| May 18 to May 27, . | 2 72 | 1 29 | 1 03 | 1 69 | 1.30 | 882 |
| June 1 to June 19, . | 4 78 | 2 84 | 2 27 | 2 51 | 1.00 | 898 |
| June 23 to July 2, . | 2 49 | 1 54 | 1 23 | 1 26 | 0.99 | 889 |
| Total, . . | $12 11 | $6 93 | $5 55 | $6 56 | – | – |

*Composition of Fodder Articles fed during the Previously Described Feeding Experiments.*

*Corn Meal (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 11.67 | 233.40 | – | – | 1 : 9.65 |
| Dry matter, | 88.33 | 1,766.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 1.89 | 37.80 | – | – | |
| " cellulose, | 1.44 | 28.80 | 9.79 | 34 | |
| " fat, | 4.44 | 88.80 | 67.49 | 76 | |
| " protein (nitrogenous matter), | 10.46 | 209.20 | 177.82 | 85 | |
| Non-nitrogenous extract matter, | 81.77 | 1,635.40 | 1,537.28 | 94 | |
| | 100.00 | 2,000.00 | 1,792.38 | – | |

*Wheat Bran (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 9.27 | 185.40 | – | – | 1 : 3.94 |
| Dry matter, | 90.73 | 1,814.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.47 | 149.40 | – | – | |
| " cellulose, | 9.75 | 195.00 | 39.00 | 20 | |
| " fat, | 5.48 | 109.60 | 87.68 | 80 | |
| " protein (nitrogenous matter), | 17.53 | 350.60 | 308.53 | 88 | |
| Non-nitrogenous extract matter, | 59.77 | 1,195.40 | 956.32 | 80 | |
| | 100.00 | 2,000.00 | 1,391.53 | – | |

*Composition of Fodder Articles, etc.* — Continued.

*Old-process Linseed Meal (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 9.88 | 197.60 | – | – | 1 : 1.70 |
| Dry matter, | 90.12 | 1,802.40 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.39 | 147.80 | – | – | |
| " cellulose, | 8.74 | 174.80 | 45.45 | 26 | |
| " fat, | 7.24 | 144.80 | 131.77 | 91 | |
| " protein (nitrogenous matter), | 36.97 | 739.40 | 643.28 | 87 | |
| Non-nitrogenous extract matter, | 39.66 | 793.20 | 721.81 | 91 | |
| | 100.00 | 2,000.00 | 1,542.31 | – | |

*New-process Linseed Meal (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 5.06 | 101.20 | – | – | 1 : 1.26 |
| Dry matter, | 94.94 | 1,898.80 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.34 | 126.80 | – | – | |
| " cellulose, | 8.93 | 178.60 | 46.44 | 26 | |
| " fat, | 2.17 | 43.40 | 39.49 | 91 | |
| " protein (nitrogenous matter), | 41.02 | 820.40 | 713.75 | 87 | |
| Non-nitrogenous extract matter, | 41.54 | 830.80 | 756.03 | 91 | |
| | 100.00 | 2,000.00 | 1,555.71 | – | |

*Composition of Fodder Articles, etc.* — Continued.

*Hay (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 9.72 | 194.40 | – | – | 1 : 9.68 |
| Dry matter, | 90.28 | 1,805.60 | | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.43 | 128.60 | – | – | |
| " cellulose, | 32.28 | 645.60 | 374.45 | 58 | |
| " fat, | 2.49 | 49.80 | 22.91 | 46 | |
| " protein (nitrogenous matter), | 9.54 | 190.80 | 108.76 | 57 | |
| Non-nitrogenous extract matter, | 49.26 | 985.20 | 620.68 | 63 | |
| | 100.00 | 2,000.00 | 1,126.80 | – | |

*Rowen * (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 13.53 | 270.60 | – | – | 1 : 6.93 |
| Dry matter, | 86.47 | 1,729.40 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.81 | 136.20 | – | – | |
| " cellulose, | 28.31 | 566.20 | 328.40 | 58 | |
| " fat, | 3.81 | 76.20 | 35.05 | 46 | |
| " protein (nitrogenous matter), | 12.94 | 258.80 | 147.52 | 57 | |
| Non-nitrogenous extract matter), | 48.13 | 962.60 | 606.44 | 63 | |
| | 100.00 | 2,000.00 | 1,117.41 | - | |

* Dried second cut of meadow growth.

*Composition of Fodder Articles, etc.* — Continued.

*Corn Ensilage (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 72.95 | 1,459.00 | – | – | 1 : 11.67 |
| Dry matter, | 27.05 | 541.00 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.48 | 129.60 | – | – | |
| " cellulose, | 26.33 | 526.60 | 379.15 | 72 | |
| " fat, | 5.17 | 103.40 | 77.55 | 75 | |
| " protein (nitrogenous matter), | 7.64 | 152.80 | 111.54 | 73 | |
| Non-nitrogenous extract matter, | 54.38 | 1,087.60 | 728.69 | 67 | |
| | 100.00 | 2,000.00 | 1,296.93 | – | |

*Fodder Corn.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 20.42 | 408.40 | – | -- | 1 : 9.89 |
| Dry matter, | 79.58 | 1,591.60 | – | -- | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.40 | 148.00 | – | – | |
| " cellulose, | 20.11 | 402.20 | 289.58 | 72 | |
| " fat, | 1.65 | 33.00 | 24.75 | 75 | |
| " protein (nitrogenous matter), | 8.31 | 166.20 | 121.33 | 73 | |
| Non-nitrogenous extract matter, | 62.53 | 1,250.60 | 837.90 | 67 | |
| | 100.00 | 2,000.00 | 1,273.56 | – | |

*Composition of Fodder Articles, etc.* — Continued.

*Corn Stover.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 22.50 | 450.00 | – | – | 1 : 8.62 |
| Dry matter, | 77.50 | 1,550.00 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 3.97 | 79.40 | – | – | |
| " cellulose, | 34.96 | 699.20 | 503.42 | 72 | |
| " fat, | 1.54 | 30.80 | 23.10 | 75 | |
| " protein (nitrogenous matter), | 9.76 | 195.20 | 142.50 | 73 | |
| Non-nitrogenous extract matter, | 49.77 | 995.40 | 666.92 | 67 | |
| | 100.00 | 2,000.00 | 1,335.94 | – | |

*Carrots.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 90.47 | 1,809.40 | – | – | 1 : 9.25 |
| Dry matter, | 9.53 | 190.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 8.67 | 173.40 | – | – | |
| " cellulose, | 8.16 | 163.20 | 163.20 | 100 | |
| " fat, | 1.86 | 37.20 | 37.20 | 100 | |
| " protein (nitrogenous matter), | 9.18 | 183.60 | 183.60 | 100 | |
| Non-nitrogenous extract matter, | 72.13 | 1,442.60 | 1,442.60 | 100 | |
| | 100.00 | 2,000.00 | 1,826.60 | – | |

*Composition of Fodder Articles, etc.* — Concluded.

*Sugar Beets.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 90.02 | 1,800.40 | – | – | 1 : 6.74 |
| Dry matter, | 9.98 | 199.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 11.84 | 236.80 | – | – | |
| " cellulose, | 8.20 | 164.00 | 164.00 | 100 | |
| " fat, | .71 | 14.20 | 14.20 | 100 | |
| " protein (nitrogenous matter), | 11.53 | 230.60 | 230.60 | 100 | |
| Non-nitrogenous extract matter, | 67.72 | 1,354.40 | 1,354.40 | 100 | |
| | 100.00 | 2,000.00 | 1,763.20 | – | |

## 3. *Summer Feeding Experiments with Milch Cows. July 12 to Sept. 30, 1890.*

Green Crops *vs.* English Hay, first and second cut.
Green feed: vetch and oats, soja beans.
Grain feed: corn meal, wheat bran, new-process linseed meal.

A series of feeding experiments with milch cows have been carried on at the station, since 1887, for the purpose of ascertaining the feeding value of several reputed fodder crops new to our section of the country. The new fodder crops were fed in their green state, and their nutritive value, as well as their general economical merits, compared with those of a good average English hay, first and second cut (rowen). The cutting of the new fodder crops for fodder commenced at the beginning of their blooming, and continued until their maturing. Most of them had at that time some of their seeds matured, yet their stems were still succulent.

The results obtained in this connection in previous years have already been published in our previous annual reports, five, six and seven; they were considered on the whole in a sufficient degree encouraging to advise a continuation of our investigations in that direction. For details regarding the merits of Southern cow-pea, serradella, vetch, vetch and oats and vetch and barley, as substitutes in part or in the whole of an average English hay and rowen, as coarse fodder ingredients of the daily diet in case of the same kinds and the same quantities of grain feed, I have to refer to some of our previous annual reports.

*1890.* — During our late experiments, July 12 to September 30, we used the following fodder articles in the compounding of the daily diet: a mixed crop of green vetch and oats, or green soja beans, with first and second cut of dried upland meadow growth, English hay and rowen, furnished the coarse feed, while corn meal, wheat bran and new-process linseed meal (Cleveland) served as fine or grain feed. The kind and the quantity of the daily grain feed remained the same during the entire experiment, *i.e.*, corn meal, wheat bran and new-process linseed meal, each three and one-quarter pounds daily per head of cows; five pounds of hay, with all the green crop the cows would consume, finished the daily diet. The green crops were cut into pieces from six to eight inches long before being fed. One-half of the daily ration of grain feed and of green fodder was fed during milking in the morning, and the other half at milking in the evening: the hay was fed between both meals. The daily quantities of grain and of hay remained the same, both being entirely consumed. The daily consumption of the green feed, however, was decided by the appetite of the different cows: vetch and oats varied from fifty to sixty pounds, and soja beans from forty to sixty pounds. The quantity consumed per day decreased in all cases toward the maturing of the crop, on account of the gradual increase of solid matter in the crop. The following statement contains the average daily fodder rations per head; they succeeded each other in the order in which they are reported: —

*Daily Fodder Rations used.*

I.

| | |
|---|---|
| Corn meal, | 3.25 lbs. |
| Wheat bran, | 3.25 " |
| New-process linseed meal, | 3.25 " |
| Hay, | 5.00 " |
| Vetch and oats, | 54.00 " |
| Total cost, | 22.64 cts. |
| Net cost, | 12.22 " |
| Manurial value obtainable, | 10.42 " |
| Nutritive ratio, | 1:5.97 |

II.

| | |
|---|---|
| Corn meal, | 3.25 lbs. |
| Wheat bran, | 3.25 " |
| New-process linseed meal, | 3.25 " |
| Hay, | 5.00 " |
| Soja bean, | 55.00 " |
| Total cost, | 27.31 cts. |
| Net cost, | 15.02 " |
| Manurial value obtainable, | 12.29 " |
| Nutritive ratio, | 1:4.69 |

III.

| | |
|---|---|
| Corn meal, | 3.25 lbs. |
| Wheat bran, | 3.25 " |
| New-process linseed meal, | 3.25 " |
| Rowen, | 20.00 " |
| Total cost, | 26.46 cts. |
| Net cost, | 14.28 " |
| Manurial value obtainable, | 12.18 " |
| Nutritive ratio, | 1:4.92 |

*Price per Ton of the Fodder Articles used in our Valuations.*

| | |
|---|---|
| Corn meal, | $24 00 |
| Wheat bran, | 20 00 |
| New-process linseed meal, | 26 50 |
| Hay, | 15 00 |
| Vetch and oats (green), | 2 75 |
| Soja bean (green), | 4 40 |
| Rowen (dry second cut of grass), | 15 00 |

The valuation of green vetch and oats and of green soja beans is based on the value adopted for English hay, allowing two tons of English hay or six tons of green grass as the average produce per year for an acre of a good meadow.

The remaining fodder articles were sold at the stated price per ton in our local market of feed stuffs. Some information regarding the raising of vetch and oats and of soja beans will be found farther on in the description of our field experiments.

*Valuation of Essential Fertilizing Constituents contained in the Various Fodder Articles used.*

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

| | Corn Meal. | Wheat Bran. | New-process Linseed Meal | Hay. | Vetch and Oats. | Soja Beans. | Rowen. |
|---|---|---|---|---|---|---|---|
| Moisture at 100° C., | 12.39 | 11.52 | 10.06 | 9.72 | 76.21 | 72.95 | 13.53 |
| Nitrogen, | 1.466 | 2.600 | 5.392 | 1.379 | 0.293 | 0.590 | 1.790 |
| Phosphoric acid, | 0.707 | 2.870 | 1.800 | 0.352 | 0.159 | 0.193 | 0.164 |
| Potassium oxide, | 0.135 | 1.620 | 1.570 | 1.511 | 0.566 | 0.311 | 1.966 |
| Valuation per 2,000 pounds, | $6 22 | $13 71 | $21 90 | $6 50 | $1 70 | $2 52 | $8 12 |

Six cows, grades, from five to six years old, and in different stages of their milking period, were selected for the experiment. They had been fed, previous to the observation, on a daily ration of corn meal, wheat bran and new-process linseed meal, each $3\frac{1}{4}$ pounds, with all the rowen called for, — from 20 to 22 pounds per head. Their average daily milk record at that time was as follows: —

1. Jessie, . . . . . . from 7.5 to 8 quarts.
2. Roxy, . . . . . . . from 10 to 11 quarts.
3. Pink, . . . . . . . from 11 to 12 quarts.
4. Nancy, . . . . . . . from 11 to 12 quarts.
5. Juno, . . . . . . . from 9 to 10 quarts.
6. Pearl, . . . . . . . from 13 to 14 quarts.

The time of observation was subdivided into three periods, which were characterized by the change from vetch and oats to soja beans, and terminating with rowen, as the sole article of coarse food constituents. The grain feed remained the same during the three different feeding periods.

The results of the last experiment lead to similar conclusions as our preceding experiments in 1887, 1888 and 1889, with green vetch, green Southern cow-pea, green serradella and mixed green crops of vetch and oats and vetch and barley. (See Report seven, page 50.)

*Conclusions of 1890.*

1. The amount of dry matter in the feed consumed during different feeding periods for the production of one quart of milk obtained, varied from 3.32 to 3.55 pounds in case of a daily milk production of from 7 to 8 quarts (Jessie); it varied from 2.62 to 2.99 pounds (Pink), when from 9 to 10 quarts was the daily production of milk; and it was from 1.69 to 1.75 pounds per quart of milk produced when the yield rose to from 13 to 14 quarts (Pearl). The variations in the numerical relation of the amount of dry matter of the feed consumed for the production of one quart of milk, in case of the same animal and the same kind of feed, are materially due to a more or less advanced stage of the milking period of the animal on trial; yet they rarely correspond in different animals. Constitutional differences quite frequently modify the results under otherwise corresponding conditions.

2. The total cost of the feed consumed in connection with the production of one quart of milk differed during the same feeding period, in case of different animals, from 1.69 cents to 3.43 cents; 1.69 cents in case of Pearl and 3.43 cents in case of Jessie, second feeding period, — soja beans. This difference is mainly due to the rate of the daily yield of milk; yet constitutional peculiarities sometimes affect materially the final results.

3. The net cost of the feed consumed for the production of one quart of milk varied in case of different cows from 0.93 cents to 1.88 cents; Pearl 0.93 cents and Jessie 1.88 cents, second period, — soja-bean ration.

4. The market value of the obtainable manurial refuse amounts per quart of milk produced on an average to more than three-sevenths part of the entire cost of the daily fodder ration. Net cost of feed represents the money value of the feed after 80 per cent. of the manurial value of the

phosphoric acid, potassium oxide and nitrogen it contains has been deducted.

5. The soja bean exceeds in our case in five out of six cases the vetch and oats in feeding effect. Vetch and oats compare well with a good rowen. The latter leads the English hay thus far in all our observations with milk production.

6. Judging from our own experience, we can only recommend very highly the practice of raising any of the stated new fodder crops, after due consideration of local circumstances, either alone or as mixed crops, for the purpose of increasing the fodder resources of the farm during summer and autumn. They may serve as green fodder as well as hay; most of them have a higher nutritive ratio than either English hay, corn fodder or corn stover: they tend to improve the soil chemically and physically; they yield liberal returns, and are, as a rule, highly relished by cattle.

## FEEDING RECORD.

JESSIE: *Age, six years; grade, Jersey; last calf, Jan. 12, 1889.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | | Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds). | Quarts of Milk produced per Day. | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corn Meal. | Wheat Bran. | New-process Linseed Meal. | Hay. | Vetch and Oats. | Soja Bean. | Rowen. | | | | | |
| **1890.** | | | | | | | | | | | | |
| July 12 to Aug. 1, | 3.25 | 3.25 | 3.25 | 4.38 | 50.10 | – | – | 24.52 | 7.23 | 3.39 | 1 : 5.82 | 901 |
| Aug. 12 to Sept. 1, | 3.25 | 3.25 | 3.25 | 5.00 | – | 57.67 | – | 28.76 | 8.11 | 3.55 | 1 : 4.70 | 908 |
| Sept. 10 to Sept. 30, | 3.25 | 3.25 | 3.25 | – | – | – | 19.24 | 25.29 | 7.60 | 3.33 | 1 : 4.89 | 924 |

ROXY: *Age, seven years; grade, Ayrshire; last calf, Feb. 5, 1890.*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July 12 to Aug. 1, | 3.25 | 3.25 | 3.25 | 5.00 | 59.14 | – | – | 27.23 | 10.13 | 2.69 | 1 : 6.10 | 950 |
| Aug. 12 to Sept. 1, | 3.25 | 3.25 | 3.25 | 5.00 | – | 60.29 | – | 29.47 | 9.97 | 2.96 | 1 : 4.72 | 954 |
| Sept. 10 to Sept. 30, | 3.25 | 3.25 | 3.25 | – | – | – | 20.95 | 26.77 | 8.03 | 3.33 | 1 : 4.96 | 1,000 |

PINK: *Age, six years; native; last calf, Jan. 23, 1890.*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July 12 to Aug. 1, | 3.25 | 3.25 | 3.25 | 5.00 | 55.67 | – | – | 26.40 | 10.06 | 2.62 | 1 : 6.01 | 851 |
| Aug. 12 to Sept. 1, | 3.25 | 3.25 | 3.25 | 5.00 | – | 61.19 | – | 29.71 | 10.96 | 2.71 | 1 : 4.73 | 876 |
| Sept. 10 to Sept. 30, | 3.25 | 3.25 | 3.25 | – | – | – | 20.00 | 25.94 | 8.68 | 2.99 | 1 : 4.92 | 873 |

## FEEDING RECORD — *Concluded.*

NANCY: *Age, seven years; native; last calf, March 16, 1890.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | | Amount of Dry Vegetable Matter contained in the Daily Fodder consumed (Pounds). | Quarts of Milk produced per Day. | Pounds of Dry Matter per Quart of Milk. | Nutritive Ratio. | Average Weight of Animal during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corn Meal. | Wheat Bran. | New-process Linseed Meal. | Hay. | Vetch and Oats. | Soja Bean. | Rowen. | | | | | |
| **1890.** | | | | | | | | | | | | |
| July 12 to Aug. 1, | 3.25 | 3.25 | 3.25 | 4.81 | 52.48 | – | – | 25.47 | 11.23 | 2.27 | 1 : 5.92 | 877 |
| Aug. 12 to Sept. 1, | 3.25 | 3.25 | 3.25 | 5.00 | – | 54.33 | – | 27.86 | 11.42 | 2.44 | 1 : 4.69 | 868 |
| Sept. 10 to Sept. 30, | 3.25 | 3.25 | 3.25 | – | – | – | 19.57 | 25.57 | 10.61 | 2.41 | 1 : 4.90 | 893 |

JUNO: *Age, seven years; grade, Ayrshire; last calf, June 22, 1889.*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| July 12 to Aug. 1, | 3.25 | 3.25 | 3.25 | 4.71 | 51.33 | – | – | 25.11 | 9.09 | 2.76 | 1 : 5.88 | 1,097 |
| Aug. 12 to Sept. 1, | 3.25 | 3.25 | 3.25 | 5.00 | – | 55.19 | – | 28.09 | 8.67 | 3.24 | 1 : 4.69 | 1,104 |
| Sept 10 to Sept. 30, | 3.25 | 3.25 | 3.25 | – | – | – | 20.90 | 26.72 | 8.16 | 3.27 | 1 : 4.96 | 1,139 |

PEARL: *Age, five years; native; last calf, Aug. 8, 1890.*

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aug. 19 to Sept. 4, | 3.25 | 3.25 | 3.25 | 5.00 | – | 40.88 | – | 24.22 | 14.32 | 1.69 | 1 : 4.60 | 777 |
| Sept. 10 to Sept. 30, | 3.25 | 3.25 | 3.25 | – | – | – | 18.52 | 24.66 | 13.30 | 1.85 | 1 : 4.85 | 796 |

## Total Cost of Feed per Quart of Milk.

*Jessie.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds.) | Total Amount of Hay consumed (Pounds). | Total Amount of Vetch and Oats consumed (Pounds). | Total Amount of Soja Bean consumed (Pounds). | Total Amount of Rowen consumed. | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1890.** | | | | | | | | | | | |
| July 12 to Aug. 1, | 151.86 | 7.23 | 68.25 | 68.25 | 68.25 | 92.00 | 1,052.00 | – | – | $4 54 | 2.99 |
| Aug. 12 to Sept. 1, | 170 35 | 8 11 | 68.25 | 68.25 | 68.25 | 105.00 | – | 1,211,00 | – | 5 85 | 3.43 |
| Sept. 10 to Sept. 30, | 159.65 | 7.60 | 68.25 | 68.25 | 68.25 | – | – | – | 404.00 | 5 43 | 3 40 |

*Roxy.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds.) | Total Amount of Hay consumed (Pounds). | Total Amount of Vetch and Oats consumed (Pounds). | Total Amount of Soja Bean consumed (Pounds). | Total Amount of Rowen consumed. | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| July 12 to Aug. 1, | 212.79 | 10.13 | 68.25 | 68.25 | 68.25 | 105.00 | 1,242.00 | – | – | $4 90 | 2.30 |
| Aug. 12 to Sept. 1, | 209.42 | 9.97 | 68.25 | 68.25 | 68.25 | 105.00 | – | 1,266.00 | – | 5 98 | 2.86 |
| Sept. 10 to Sept. 30, | 168.72 | 8.03 | 68.25 | 68.25 | 68.25 | – | – | – | 440.00 | 5 70 | 3.38 |

*Pink.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds.) | Total Amount of Hay consumed (Pounds). | Total Amount of Vetch and Oats consumed (Pounds). | Total Amount of Soja Bean consumed (Pounds). | Total Amount of Rowen consumed. | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| July 12 to Aug. 1, | 211.28 | 10.06 | 68.25 | 68 25 | 68.25 | 105.00 | 1,169.00 | – | – | $4 80 | 2.27 |
| Aug. 12 to Sept. 1, | 230.12 | 10.96 | 68 25 | 68.25 | 68.25 | 105.00 | – | 1,285.00 | – | 6 02 | 2 62 |
| Sept. 10 to Sept. 30, | 182.33 | 8.68 | 68.25 | 68.25 | 68.25 | – | – | – | 420.00 | 5 55 | 3.04 |

TOTAL COST OF FEED PER QUART OF MILK — *Concluded.*

*Nancy.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Vetch and Oats consumed (Pounds). | Total Amount of Soja Bean consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1890.** | | | | | | | | | | | |
| July 12 to Aug. 1 . . . . . | 235.93 | 11 23 | 68.25 | 68.25 | 68.25 | 101.00 | 1,102.00 | – | – | $4 68 | 1.98 |
| Aug. 12 to Sept. 1, . . . . . | 239.77 | 11.42 | 68 25 | 68.25 | 68.25 | 105.00 | – | 1,141.00 | – | 5 70 | 2 38 |
| Sept. 10 to Sept. 30, . . . . . | 222.79 | 10.61 | 68.25 | 68.25 | 68.25 | – | – | – | 411.00 | 5 48 | 2.46 |

*Juno.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Vetch and Oats consumed (Pounds). | Total Amount of Soja Bean consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| July 12 to Aug. 1, . . . . . | 190.96 | 9.09 | 68.25 | 68 25 | 68.25 | 99.00 | 1,078.00 | – | – | $4 63 | 2.42 |
| Aug. 12 to Sept. 1, . . . . . | 182.09 | 8 67 | 68.25 | 68.25 | 68.25 | 105.00 | – | 1,159.00 | – | 5 74 | 3.15 |
| Sept. 10 to Sept. 30, . . . . . | 171.40 | 8.16 | 68.25 | 68.25 | 68.25 | – | – | – | 439.00 | 5 69 | 3.32 |

*Pearl.*

| FEEDING PERIODS. | Total Quantity of Milk produced (Quarts). | Average Daily Yield of Milk (Quarts). | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of New-process Linseed Meal consumed (Pounds). | Total Amount of Hay consumed (Pounds). | Total Amount of Vetch and Oats consumed (Pounds). | Total Amount of Soja Bean consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Cost of Feed consumed. | Average Cost of Feed for Production of One Quart of Milk (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aug. 19 to Sept. 4, . . . . . | 243.37 | 14.32 | 55 25 | 55.25 | 55.25 | 85.00 | – | 695.00 | – | $4 11 | 1 69 |
| Sept. 10 to Sept. 30, . . . . . | 279.30 | 13.30 | 68.25 | 68.25 | 68.25 | – | – | – | 389.00 | 5 32 | 1 90 |

### Net Cost of Milk and Manurial Value of Feed.

*Jessie.*

| Feeding Periods. | Total Cost of Feed consumed during Period. | Value of Fertilizing Constituents contained in the Feed. | Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk. | Net Cost of Feed for the Production of Milk. | Net Cost of Feed for the Production of One Quart of Milk. | Weight of Animal at Close of Period. |
|---|---|---|---|---|---|---|
| **1890.** | | | | | Cents. | Pounds. |
| July 12 to Aug. 1, . | $4 54 | $2 62 | $2 10 | $2 44 | 1.61 | 900 |
| Aug. 12 to Sept. 1, . | 5 85 | 3 30 | 2 64 | 3 21 | 1.88 | 900 |
| Sept. 10 to Sept. 30, . | 5 43 | 3 13 | 3 50 | 2 93 | 1.84 | 940 |
| Total, . . | $15 82 | $9 05 | $7 24 | $8 58 | – | – |

*Roxy.*

| | | | | | | |
|---|---|---|---|---|---|---|
| July 12 to Aug. 1, . | $4 90 | $2 83 | $2 26 | $2 64 | 1.24 | 960 |
| Aug. 12 to Sept. 1, . | 5 98 | 3 37 | 2 70 | 3 28 | 1.57 | 945 |
| Sept. 10 to Sept. 30, . | 5 70 | 3 28 | 2 62 | 3 08 | 1.83 | 1,013 |
| Total, . . | $16 58 | $9 48 | $7 58 | $9 00 | – | – |

*Pink.*

| | | | | | | |
|---|---|---|---|---|---|---|
| July 12 to Aug. 1, . | $4 80 | $2 76 | $2 21 | $2 59 | 1.23 | 865 |
| Aug. 12 to Sept. 1, . | 6 02 | 3 39 | 2 71 | 3 31 | 1.44 | 880 |
| Sept. 10 to Sept. 30, . | 5 55 | 3 20 | 2 56 | 2 99 | 1.64 | 874 |
| Total, . . | $16 37 | $9 35 | $7 48 | $8 89 | – | – |

*Nancy.*

| | | | | | | |
|---|---|---|---|---|---|---|
| July 12 to Aug. 1, . | $4 68 | $2 70 | $2 16 | $2 52 | 1.07 | 880 |
| Aug. 12 to Sept. 1, . | 5 70 | 3 21 | 2 57 | 3 13 | 1.31 | 870 |
| Sept. 10 to Sept. 30, . | 5 48 | 3 16 | 2 53 | 2 95 | 1.32 | 905 |
| Total, . . | $15 86 | $9 07 | $7 26 | $8 60 | – | – |

NET COST OF MILK AND MANURIAL VALUE OF FEED — *Concluded.*

*Juno.*

| FEEDING PERIODS. | Total Cost of Feed consumed during Period. | Value of Fertilizing Constituents contained in the Feed. | Manurial Value of the Feed after deducting Twenty Per Cent. taken by the Milk. | Net Cost of Feed for the Production of Milk. | Net Cost of Feed for the Production of One Quart of Milk. | Weight of Animal at Close of Period. |
|---|---|---|---|---|---|---|
| **1890.** | | | | | Cents. | Pounds. |
| July 12 to Aug. 1, . | $4 63 | $2 67 | $2 14 | $2 49 | 1.30 | 1,105 |
| Aug. 12 to Sept. 1, . | 5 74 | 3 23 | 2 58 | 3 16 | 1.74 | 1,105 |
| Sept. 10 to Sept. 30, . | 5 69 | 3 28 | 2 62 | 3 07 | 1.79 | 1,160 |
| Total, . . | $16 06 | $9 18 | $7 34 | $8 72 | – | – |

*Pearl.*

| | | | | | | |
|---|---|---|---|---|---|---|
| Aug. 19 to Sept. 4, . | $4 11 | $2 31 | $1 85 | $2 26 | 0.93 | 772 |
| Sept 10 to Sept. 30, . | 5 32 | 3 07 | 2 45 | 2 87 | 1.03 | 810 |
| Total, . . | $9 43 | $5 38 | $4 30 | $5 13 | – | – |

ANALYSES OF MILK.

*Jessie.*

| | July 15. | July 22. | July 29. | Aug. 19. | Aug. 26. | Sept. 16. | Sept. 23. | Sept. 30. |
|---|---|---|---|---|---|---|---|---|
| Solids, . . | 16.23 | 15.57 | 15.31 | 16.36 | 14.92 | 14.18 | 14.51 | 14.20 |
| Fat, . . . | 6.87 | 6.09 | 6.07 | 6.18 | 5.87 | 5.38 | 5.35 | 5.33 |
| Solids not fat, . | 9.36 | 9.48 | 9.24 | 10 18 | 9.05 | 8.80 | 9.16 | 8.87 |

*Roxy.*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Solids, . . | 13.45 | 13.37 | 13 00 | 14.72 | 14.00 | 12.43 | 13.82 | 14.18 |
| Fat, . . . | 4.17 | 4.03 | 2.63 | 4.87 | 4.29 | 3 32 | 4.52 | 4.71 |
| Solids not fat, . | 9.28 | 9.34 | 10 37 | 9.85 | 9 71 | 9.11 | 9 30 | 9.47 |

ANALYSES OF MILK — *Concluded.*

*Pink.*

| | July 15. | July 22. | July 29. | Aug. 19. | Aug. 26. | Sept. 16. | Sept. 23. | Sept. 30. |
|---|---|---|---|---|---|---|---|---|
| Solids, . . | 15.15 | 15.26 | 14.57 | 15 03 | 15.57 | 14 59 | 15 22 | 14 82 |
| Fat, . . . | 5.19 | 5.60 | 5.12 | 5.17 | 5.68 | 5 37 | 5 89 | 5.28 |
| Solids not fat, . | 9 96 | 9 66 | 9.45 | 9 86 | 9.89 | 9.22 | 9.33 | 9.54 |

*Nancy.*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Solids, . . | 13.21 | 13.29 | 13.31 | 13.92 | 14.18 | 12 54 | 13.85 | 12.61 |
| Fat, . . . | 4.22 | 4 02 | 4.18 | 4.56 | 4.48 | 4.02 | 5.14 | 4.03 |
| Solids not fat, . | 8.99 | 9 27 | 9.13 | 9.36 | 9.70 | 8.52 | 8 71 | 8.58 |

*Juno.*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Solids, . . | 13.84 | 13.56 | 13 94 | 14 48 | 14 58 | 13 39 | 13 71 | 13.62 |
| Fat, . . . | 4.70 | 4.13 | 4.51 | 4 63 | 4.73 | 4 66 | 4.81 | 4.53 |
| Solids not fat, . | 9.14 | 9.43 | 9.43 | 9.85 | 9 85 | 8 73 | 8.90 | 9.09 |

*Pearl.*

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Solids, . . | – | – | – | 14 22 | 13 78 | 11 36 | 11.99 | 11.52 |
| Fat, . . . | – | – | – | 4 48 | 4 45 | 2 98 | 3 62 | 3.23 |
| Solids not fat, . | – | – | – | 9.74 | 9.33 | 8.38 | 8 37 | 8 29 |

## Composition of Fodder Articles fed during the Previously Described Experiment.

*Corn Meal (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., . . | 12.39 | 247.80 | – | – | 1 : 9.70 |
| Dry matter, . . . | 87.61 | 1,752.20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, . . . . | 1.80 | 36.00 | – | – | |
| " cellulose, . . . | 1.80 | 36.00 | 12.24 | 34 | |
| " fat, . . . . . | 5.01 | 100.20 | 76.15 | 76 | |
| " protein (nitrogenous matter), . . | 10.46 | 209.20 | 177.82 | 85 | |
| Non-nitrogenous extract matter, . . . . | 80.93 | 1,618.60 | 1,521.48 | 94 | |
| | 100.00 | 2,000.00 | 1,787.69 | – | |

*New-process Linseed Meal.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., . . | 10.06 | 201.20 | – | – | 1 : 1.54 |
| Dry matter, . . . | 89.94 | 1,798.80 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, . . . . | 6.17 | 123.40 | – | – | |
| " cellulose, . . . | 9.22 | 184.40 | 47.94 | 26 | |
| " fat, . . . . . | 3.61 | 72.20 | 65.70 | 91 | |
| " protein (nitrogenous matter), . . | 37.47 | 749.40 | 651.98 | 87 | |
| Non-nitrogenous extract matter, . . . . | 43.53 | 870.60 | 792.25 | 91 | |
| | 100.00 | 2,000.00 | 1,557.87 | – | |

COMPOSITION OF FODDER ARTICLES, ETC. — *Continued.*

*Wheat Bran.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 11.52 | 230.40 | – | – | 1 : 3.71 |
| Dry matter, | 88.48 | 1,769.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.13 | 142.60 | – | – | |
| " cellulose, | 10.63 | 212.60 | 42.52 | 20 | |
| " fat, | 5.62 | 112.40 | 89.92 | 80 | |
| " protein (nitrogenous matter), | 18.36 | 367.20 | 323.14 | 88 | |
| Non-nitrogenous extract matter, | 58.26 | 1,165.20 | 932.16 | 80 | |
| | 100.00 | 2,000 00 | 1,387.74 | – | |

*Vetch and Oats.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 76.21 | 1,524.20 | – | – | 1 : 11.72 |
| Dry matter, | 23.79 | 475.80 | – | – | |
| | 100.00 | 2,000 00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.25 | 145.00 | – | – | |
| " cellulose, | 31.73 | 634.60 | – | – | |
| " fat, | 3.37 | 67.40 | 33.70 | 50 | |
| " protein (nitrogenous matter), | 7.70 | 154.00 | 92.40 | 60 | |
| Non-nitrogenous extract matter, | 49.95 | 999.00 | 999.00 | 100 | |
| | 100.00 | 2,000.00 | 1,125.10 | – | |

COMPOSITION OF FODDER ARTICLES, ETC. — *Concluded.*

*Soja Beans.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 72.95 | 1,459.00 | - | - | 1:5.43 |
| Dry matter, | 27.05 | 541.00 | - | - | |
| | 100.00 | 2,000.00 | - | - | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 11.05 | 221.00 | - | - | |
| " cellulose, | 24.73 | 494.60 | 355.12 | 71.8 | |
| " fat, | 7.22 | 144.40 | 26.28 | 18.2 | |
| " protein (nitrogenous matter), | 13.64 | 272.80 | 174.59 | 64 | |
| Non-nitrogenous extract matter, | 43.36 | 867.20 | 527.26 | 60.8 | |
| | 100.00 | 2,000.00 | 1,083.25 | - | |

For analysis of English hay, see preceding feeding records for 1889–90.

## *4. Creamery Record of the Station for the Years 1889 and 1890.*

The cost of feed consumed is based on the market price of the various ingredients, as is stated in the subsequent table. The valuation of the whole milk is taken at three cents per quart. The estimates of the value of fertilizing ingredients contained in the feed are also based on those given in the following table: —

*Local Market Value per Ton of the Various Articles of Fodder used.*

| | |
|---|---|
| Corn meal, | $23 00 |
| Corn and cob meal, | 20 70 |
| Wheat bran, | 21 50 |
| Rye middlings, | 21 50 |
| Gluten meal, | 23 00 |
| New-process linseed meal, | 26 00 |
| Old-process linseed meal, | 27 00 |

*Local Market Value per Ton, etc.* — Concluded.

| | | | |
|---|---|---|---|
| Hay, | $15 00 | Soja bean (green), | $4 40 |
| Rowen, | 15 00 | Vetch and oats (green), | 2 75 |
| Corn fodder, | 5 00 | Vetch (green), | 3 50 |
| Corn stover, | 5 00 | Serradella (green), | 3 16 |
| Corn ensilage, | 2 25 | Cow-pea (green), | 3 14 |
| Millet (dry), | 12 00 | Barley and horse bean (green), | 3 00 |
| Lucerne and vetch (dry), | 12 00 | Potatoes, | 6 67 |
| Lucerne and clover (dry), | 12 00 | Carrots, | 7 00 |
| Oats (dry), | 12 00 | Sugar beets, | 5 00 |
| Oats (green), | 3 60 | | |

*Valuation of the Essential Fertilizing Constituents contained in the Various Articles of Fodder used.*

Nitrogen, 16½ cents per pound; phosphoric acid, 6 cents; potassium oxide, 4¼ cents.

[Per cent.]

| | Nitrogen. | Phosphoric Acid. | Potassium Oxide. | Valuation per Ton. |
|---|---|---|---|---|
| Corn meal, | 1.86 | 0.77 | 0.45 | $7 41 |
| Corn and cob meal, | 1.46 | 0.603 | 0.441 | 5 91 |
| Wheat bran, | 2.82 | 3.05 | 1.49 | 14 24 |
| Rye middlings, | 1.84 | 1.26 | 0.81 | 8 27 |
| Gluten meal, | 5 22 | 0.40 | 0.05 | 17 75 |
| New-process linseed meal, | 6 25 | 1.42 | 1.16 | 23 32 |
| Old-process linseed meal, | 5.33 | 1.64 | 1.16 | 20 54 |
| Hay, | 1.25 | 0.464 | 2.085 | 6 46 |
| Rowen, | 1.93 | 0.364 | 2.86 | 9 24 |
| Corn fodder (dry), | 1.37 | 0.368 | 0.355 | 5 26 |
| Corn stover (dry), | 0.78 | 0.09 | 0.599 | 3 19 |
| Corn ensilage, | 0.36 | 0.14 | 0.33 | 1 64 |
| Millet (dry), | 1.106 | 0.38 | 2.49 | 6 23 |
| Lucerne and vetch (dry), | 2.02 | 0.70 | 2.273 | 9 11 |
| Lucerne and clover (dry), | 2.06 | 0.623 | 1 805 | 9 08 |
| Oats (dry), | 1.47 | 0 51 | 2 41 | 7 51 |
| Oats (green), | 0.33 | 0.155 | 0.68 | 1 85 |

*Valuation of Essential Fertilizing Constituents, etc.* — Concluded.

| | Nitrogen. | Phosphoric Acid. | Potassium Oxide. | Valuation per Ton. |
|---|---|---|---|---|
| Soja bean (green), | 0.590 | 0.193 | 0.311 | $2 44 |
| Vetch and oats (green), | 0.23 | 0.09 | 0.79 | 1 54 |
| Vetch (green), | 0.49 | 0.20 | 0.66 | 2 42 |
| Serradella (green), | 0.411 | 0.14 | 0.423 | 1 89 |
| Cow-pea (green), | 0.561 | 0.098 | 0.306 | 2 23 |
| Barley and beans (green), | 0.50 | 0.20 | 0.40 | 2 23 |
| Potatoes, | 0.476 | 0.18 | 0.56 | 2 18 |
| Carrots, | 0.14 | 0.10 | 0.54 | 1 04 |
| Sugar beets, | 0.29 | 0.03 | 0.18 | 1 15 |

The value of cream is that granted us from month to month by our local creamery association. The station has no other connection with the financial management of the creamery.

Our presentation of financial results is based on the local cost of feed alone, and does not consider interest on investment and labor involved; for the reason that approximate estimates on these points are in an exceptional degree dependent on quality of stock, and varying local circumstances. The details are embodied in a few subsequent tables under the following headings: —

1. Statement of articles of fodder used.
2. Record of average quality of milk and of fodder rations.
3. Value of cream produced at creamery basis of valuation.
4. Cost of skim-milk at the selling price of three cents per quart of whole milk.
5. Fertilizing constituents of cream.
6. Some conclusions suggested by the records.
7. Analyses of cream, and modes of analysis of milk, cream and butter.

*1. Statement of Articles of Fodder used during 1889 (in Pounds).*

| | Corn Meal. | Wheat Bran. | Gluten Meal. | Old-process Linseed Meal. | Hay. | Rowen. | Fodder Corn. | Corn Stover. | Corn Ensilage. | Vetch and Oats. | Serradella. | Cow-pea. | Carrots. | Sugar Beets. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, . . | 608.75 | 604.75 | 584.75 | - | 1,772.00 | - | - | - | 1,475.00 | - | - | - | 4,868.00 | - |
| February, . . | 552.50 | 552.50 | 552.50 | - | 1,268.50 | - | - | - | 5,069.50 | - | - | - | - | - |
| March, . . | 591.50 | 591.50 | 591.50 | - | 2,396.00 | - | - | - | - | - | - | - | - | 4,084.00 |
| April, . . . | 572.00 | 562.25 | 563.88 | - | 2,395.50 | 838.00 | - | - | - | - | - | - | - | 1,125.00 |
| May, . . . | 604.50 | 583.38 | 604.50 | - | 900.50 | 2,713.50 | - | - | - | - | - | - | - | - |
| June, . . . | 585.00 | 585.00 | 585.00 | - | 1,858.50 | 1,295.50 | - | - | - | 582.75 | - | - | - | - |
| July, . . . | 604.50 | 604.50 | 604.50 | - | 434.00 | 1,871.00 | - | - | - | 4,308.75 | - | - | - | - |
| August, . . | 402.00 | 402.00 | 402.00 | - | 180.00 | 3,755.25 | - | - | - | - | - | 1,512.00 | - | - |
| September, . . | 585.00 | 585.00 | 585.00 | - | 1,002.00 | - | - | - | - | - | 8,182.50 | 4,983.00 | - | - |
| October, . . | 604.50 | 604.50 | 604.50 | - | 3,574.50 | - | - | - | - | - | - | - | - | - |
| November, . . | 585.00 | 585.00 | 585.00 | - | 3,491.50 | - | - | - | - | - | - | - | - | - |
| December, . . | 604.50 | 604.50 | 88.00 | 516.50 | 3,451.00 | - | - | - | - | - | - | - | - | - |

*1. Statement of Articles of Fodder used during 1890 (in Pounds).*

| | Corn Meal. | Wheat Bran. | Gluten Meal. | Old-process Linseed Meal. | New-process Linseed Meal. | Cotton-seed Meal. | Hay. | Rowen. | Fodder Corn. | Corn Stover. | Corn Ensilage. | Vetch and Oats. | Soja Beans. | Carrots. | Sugar Beets. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, . | 604.50 | 604.50 | - | 604.50 | - | - | 1,016.00 | - | - | - | 7,737.50 | - | - | - | - |
| February, . | 370.50 | 546.00 | - | 529.75 | - | - | 514.00 | - | 850.50 | - | 4,687.50 | - | - | 1,080.00 | - |
| March, . | - | 604.50 | - | 604.50 | - | - | - | - | 1,132.00 | 1,665.00 | - | - | - | 3,680.00 | - |
| April, . . | 184.50 | 577.50 | - | 106.50 | 444.00 | - | 977.00 | - | 1,201.50 | 472.50 | - | - | - | 2,520.00 | 1,080.00 |
| May, . . | 604.50 | 604.50 | - | 340.50 | 262.50 | - | 2,656.50 | 360.00 | - | - | - | - | - | - | 3,240.00 |
| June, . . | 585.00 | 585.00 | - | 379 50 | 204.00 | - | - | 3,723.50 | - | - | - | - | - | - | - |
| July, . . | 604.50 | 604.50 | - | - | 604.50 | - | 725.50 | 613.00 | - | - | - | 7,463.00 | - | - | - |
| August, . | 604.50 | 604.50 | - | - | 604.50 | - | 920.00 | - | - | - | - | 910 50 | 8,882.50 | - | - |
| September, . | 585.00 | 585.00 | - | - | 585.00 | - | 120.00 | 2,935.00 | - | - | - | - | 1,767.00 | - | - |
| October, . | 571.50 | 571.50 | - | - | 223.50 | 348.00 | - | 3,221.50 | - | - | - | - | - | - | - |

## 2. *Record of Average Quality of Milk and of Fodder Rations (1889).*

| 1889. | Average Percentage of Solids in Milk. | Average Percentage of Fat in Milk. | Quarts of Milk required to make One Space of Cream. | Nutritive Ratio of Feed. | Feed consumed per Day (in Pounds). Corn Meal. | Wheat Bran. | Gluten Meal. | Old-process Linseed Meal. | Hay. | Rowen. | Fodder Corn. | Corn Ensilage. | Carrots. | Sugar Beets. | Vetch and Oats. | Serradella. | Cow-pea. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, | 14.49 | 3.90 | 1.76 | 1 : 6.21 | 3.25 | 3.25 | 3.25 | - | 10.00 | - | - | - | 39.57 | - | - | - | - |
| February, | 13.93 | 4.29 | 1.71 | 1 : 6.57 | 3.25 | 3.25 | 3.25 | - | 5.00 | - | - | 36.51 | - | - | - | - | - |
| March, | 14.12 | 4.36 | 1.65 | 1 : 5.99 | 3.25 | 3.25 | 3.25 | - | 16.40 | - | - | - | - | - | - | - | - |
| | | | | 1 : 6.14 | 3.25 | 3.25 | 3.25 | - | 10.00 | - | - | - | - | 45.60 | - | - | - |
| April, | 14.14 | 4.56 | 1.62 | 1 : 6.12 | 3.25 | 3.25 | 3.25 | - | 18.38 | - | - | - | - | - | - | - | - |
| May, | 14.03 | 4.34 | 1.60 | 1 : 5.21 | 3.25 | 3.25 | 3.25 | - | - | 19.53 | - | - | - | - | - | - | - |
| June, | 14.42 | 4.58 | 1.62 | 1 : 5.30 | 3.25 | 3.25 | 3.25 | - | - | 20.60 | - | - | - | - | - | - | - |
| | | | | 1 : 6.18 | 3.25 | 3.25 | 3.25 | - | 18.00 | - | - | - | - | - | - | - | - |
| July, | 13.92 | 4.30 | 1.72 | 1 : 6.38 | 3.25 | 3.25 | 3.25 | - | 5.00 | - | - | - | - | - | 46.50 | - | - |
| | | | | 1 : 5.30 | 3.25 | 3.25 | 3.25 | - | - | 20.60 | - | - | - | - | - | - | - |
| August, | 13.85 | 4.21 | 1.70 | 1 : 5.62 | 3.25 | 3.25 | 3.25 | - | - | 24.10 | - | - | - | - | - | - | - |
| September, | 13.82 | 4.48 | 1.65 | 1 : 6.05 | 3.25 | 3.25 | 3.25 | - | 5.00 | - | - | - | - | - | - | - | 76.23 |
| | | | | 1 : 4.70 | 3.25 | 3.25 | 3.25 | - | 5.00 | - | - | - | - | - | - | 78.23 | - |
| October, | 14.34 | 4.72 | 1.53 | 1 : 6.26 | 3.25 | 3.25 | 3.25 | - | 19.30 | - | - | - | - | - | - | - | - |
| November, | - | - | 1.53 | 1 : 6.26 | 3.25 | 3.25 | 3.25 | - | 19.40 | - | - | - | - | - | - | - | - |
| December, | 14.33 | 4.64 | 1.44 | 1 : 5.72 | 3.25 | 3.25 | - | 3.25 | 18.41 | - | - | - | - | - | - | - | - |
| Averages, | 14.12 | 4.39 | 1.63 | 1 : 5.88 | | | | | | | | | | | | | |

## 2. *Record of Average Quality of Milk and of Fodder Rations (1890).*

| 1890. | Average Percentage of Solids in Milk. | Average Percentage of Fat in Milk. | Quarts of Milk required to make one Space of Cream. | Nutritive Ratio of Feed. | Feed consumed per Day (in Pounds). Corn Meal. | Wheat Bran. | Gluten Meal. | Old-process Linseed Meal. | New-process Linseed Meal. | Cotton-seed Meal. | Hay. | Rowen. | Fodder Corn. | Corn Stover. | Corn Ensilage. | Vetch and Oats. | Soja Bean. | Carrots. | Sugar Beets. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January, . | 14.18 | 4.72 | 1.45 | 1 : 6.25 | 3.25 | 3.25 | - | 3.25 | - | - | 5.00 | - | - | - | 44.74 | - | - | - | - |
| February, . | 14.02 | 4.64 | 1.51 | 1 : 6.25 | 3.25 | 3.25 | - | 3.25 | - | - | 5.00 | - | - | - | 44.74 | - | - | - | - |
| | | | | 1 : 5.14 | - | 3.25 | - | 3.25 | - | - | - | - | 13.74 | - | - | - | - | 20.00 | - |
| March, . | 14.21 | 4.99 | 1.57 | 1 : 5.14 | - | 3.25 | - | 3.25 | - | - | - | - | 13.74 | - | - | - | - | 20.00 | - |
| | | | | 1 : 5.14 | - | 3.25 | - | 3.25 | - | - | - | - | - | 16.00 | - | - | - | 20.00 | - |
| April, . | 13.37 | 4.42 | 1.66 | 1 : 4.95 | - | 3.25 | - | - | 3.25 | - | - | - | 16.13 | - | - | - | - | 20.00 | - |
| | | | | 1 : 5.22 | 3.25 | 3.25 | - | - | 3.25 | - | 15.90 | - | - | - | - | - | - | - | 20.00 |
| May, . . | 13.73 | 4.38 | 1.75 | 1 : 5.22 | 3.25 | 3.25 | - | - | 3.25 | - | 15.90 | - | - | - | - | - | - | - | 20.00 |
| | | | | 1 : 5.60 | 3.25 | 3.25 | - | 3.25 | - | - | 15.67 | - | - | - | - | - | - | - | 20.00 |
| June, . . | 13.42 | 4.39 | 1.76 | 1 : 5.04 | 3.25 | 3.25 | - | 3.25 | - | - | - | 20.60 | - | - | - | - | - | - | - |
| | | | | 1 : 4.73 | 3.25 | 3.25 | - | - | 3.25 | - | - | 20.75 | - | - | - | - | - | - | - |
| July, . . | 13.91 | 4.45 | 1.67 | 1 : 5.96 | 3.25 | 3.25 | - | - | 3.25 | - | 5.00 | - | - | - | - | 53.75 | - | - | - |
| August, . | 14.65 | 4.95 | 1.61 | 1 : 4.69 | 3.25 | 3.25 | - | - | 3.25 | - | 5.00 | - | - | - | - | - | 55.00 | - | - |
| September, | 13.47 | 4.57 | 1.59 | 1 : 4.91 | 3.25 | 3.25 | - | - | 3.25 | - | - | 19.86 | - | - | - | - | - | - | - |
| October, . | 13.84 | 4.82 | 1.56 | 1 : 4.91 | 3.25 | 3.25 | - | - | 3.25 | - | - | 19.86 | - | - | - | - | - | - | - |
| | | | | 1 : 4.84 | 3.00 | 3.00 | - | - | - | 3.00 | - | 19.25 | - | - | - | - | - | - | - |
| Averages, | 13.88 | 4.63 | 1.61 | 1 : 5.25 | | | | | | | | | | | | | | | |

*3. Value of Cream produced at Creamery Basis of Valuation.*

| | Total Cost of Feed consumed. | Total Value of Fertilizing Constituents of Food consumed. | Value of Fertilizing Constituents lost in Cream. | Net Cost of Feed for Production of Cream. | Value of Cream produced. |
|---|---|---|---|---|---|
| **1889.** | | | | | |
| January, | $52 21 | $21 23 | $0 66 | $31 64 | $40 60 |
| February, | 33 86 | 19 15 | 0 63 | 15 34 | 36 19 |
| March, | 48 14 | 21 77 | 0 75 | 27 11 | 42 48 |
| April, | 46 17 | 23 40 | 0 78 | 23 55 | 42 84 |
| May, | 47 28 | 27 23 | 0 83 | 20 88 | 39 28 |
| June, | 44 21 | 23 98 | 0 72 | 20 95 | 33 06 |
| July, | 43 63 | 25 28 | 0 76 | 19 11 | 34 92 |
| August, | 45 44 | 27 54 | 0 76 | 18 66 | 36 33 |
| September, | 48 01 | 28 08 | 0 73 | 20 66 | 38 25 |
| October, | 47 21 | 23 47 | 0 71 | 24 45 | 39 06 |
| November, | 45 93 | 22 82 | 0 66 | 23 77 | 36 11 |
| December, | 47 18 | 24 38 | 0 67 | 23 47 | 36 68 |
| Averages, | $45 77 | $24 03 | $0 72 | $22 46 | $37 98 |
| **1890.** | | | | | |
| January, | $37 78 | $23 07 | $0 64 | $15 35 | $33 99 |
| February, | 32 19 | 19 62 | 0 69 | 13 26 | 36 93 |
| March, | 31 38 | 19 75 | 0 66 | 15 29 | 37 52 |
| April, | 38 54 | 19 75 | 0 68 | 19 47 | 32 40 |
| May, | 52 09 | 25 32 | 0 73 | 27 50 | 33 45 |
| June, | 48 33 | 30 05 | 0 72 | 19 30 | 30 66 |
| July, | 41 65 | 23 90 | 0 68 | 18 43 | 29 04 |
| August, | 49 09 | 27 52 | 0 73 | 22 30 | 39 27 |
| September, | 47 43 | 28 68 | 0 72 | 19 47 | 42 05 |
| October, | 44 48 | 27 82 | 0 65 | 17 31 | 39 92 |
| Averages, | $42 63 | $24 55 | $0 69 | $18 77 | $35 52 |

## 4. *Cost of Skim-milk at the Selling Price of Three Cents per Quart for Whole Milk.*

| | Quarts of Milk produced. | Spaces of Cream. | Quarts of Cream (One Quart equals 3.4 Spaces). | Quarts of Skim-milk. | Value of Cream per Space (Cents). | Value of Cream per Quart of Milk (Cents). | Total Value of Cream. | Cost of Skim-milk per Quart (Whole Milk at Three Cents per Quart). | Total Cost of Skim-milk. |
|---|---|---|---|---|---|---|---|---|---|
| **1889.** | | | | | | | | Cents. | |
| January, . | 1,791.1 | 1,015 | 298.5 | 1,492.6 | 4.00 | 2.27 | $40 60 | 0.88 | $13 13 |
| February, . | 1,680.0 | 965 | 283.8 | 1,396.2 | 3.75 | 2.15 | 36 19 | 1.02 | 14 21 |
| March, . . | 1,895.0 | 1,148 | 337.6 | 1,557.4 | 3.70 | 2.24 | 42 48 | 0.92 | 14 37 |
| April, . . | 1,931.6 | 1,190 | 350.0 | 1,581.6 | 3.60 | 2.22 | 42 84 | 0.96 | 15 11 |
| May, . . | 2,025.2 | 1,267 | 372.6 | 1,652.6 | 3.10 | 1.94 | 39 28 | 1.30 | 21 48 |
| June, . . | 1,785.6 | 1,102 | 324.1 | 1,461.5 | 3.00 | 1.85 | 33 06 | 1.40 | 20 51 |
| July, . . | 2,001.2 | 1,164 | 342.4 | 1,658.8 | 3.00 | 1.74 | 34 92 | 1.51 | 25 12 |
| August, . . | 1,991.9 | 1,172 | 344.7 | 1,647.2 | 3.10 | 1.82 | 36 33 | 1.42 | 23 43 |
| September, . | 1,856.0 | 1,125 | 330.9 | 1,525.1 | 3.40 | 2.06 | 38 25 | 1.14 | 17 43 |
| October, . | 1,665.0 | 1,085 | 319.1 | 1,345.9 | 3.60 | 2.35 | 39 06 | 0.81 | 10 89 |
| November, . | 1,538.1 | 1,003 | 295.0 | 1,243.1 | 3.60 | 2.35 | 36 11 | 0.81 | 10 03 |
| December, . | 1,463.8 | 1,019 | 299.7 | 1,164.1 | 3.60 | 2.51 | 36 68 | 0.62 | 7 23 |
| Averages, . | 1,802.0 | 1,105 | 324.9 | 1,477.2 | 3.45 | 2.13 | $37 98 | 1.07 | $16 08 |
| **1890.** | | | | | | | | | |
| January, . | 1,404.1 | 971 | 285.6 | 1,118.5 | 3.50 | 2.42 | $33 99 | 0.73 | $8 13 |
| February, . | 1,596.2 | 1,055 | 310.3 | 1,285.9 | 3.50 | 2.31 | 36 93 | 0.85 | 10 96 |
| March, . . | 1,594.8 | 1,014 | 298.2 | 1,296.6 | 3.70 | 2.35 | 37 52 | 0.80 | 10 32 |
| April, . . | 1,720.8 | 1,035 | 304.4 | 1,416.4 | 3.13 | 1.88 | 32 40 | 1.36 | 19 22 |
| May, . . | 1,946.7 | 1,115 | 327.9 | 1,618.8 | 3.00 | 1.72 | 33 45 | 1.54 | 24 95 |
| June, . . | 1,922.4 | 1,095 | 322.1 | 1,600.3 | 2.80 | 1.59 | 30 66 | 1.69 | 27 01 |
| July, . . | 1,727.0 | 1,037 | 305.0 | 1,422.0 | 2.80 | 1.68 | 29 04 | 1.60 | 22 77 |
| August, . . | 1,809.5 | 1,122 | 330.0 | 1,479.5 | 3.50 | 2.17 | 39 27 | 1.02 | 15 02 |
| September, . | 1,747.4 | 1,098 | 322.9 | 1,424.5 | 3.83 | 2.41 | 42 05 | 0.73 | 10 37 |
| October, . | 1,556.9 | 998 | 293.5 | 1,263.4 | 4.00 | 2.56 | 39 92 | 0.54 | 6 79 |
| Averages, . | 1,702.6 | 1,054 | 310.0 | 1,392.6 | 3.38 | 2.11 | $35 52 | 1.09 | $15 55 |

## 5. *Fertilizing Constituents of Cream.*

[Average analysis.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., . . . . . . . . . . . . . | 75.22 |
| Nitrogen ($16\frac{1}{2}$ cents per pound), . . . . . . . . . | .54 |
| Potassium oxide ($4\frac{1}{4}$ cents per pound), . . . . . . | .123 |
| Phosphoric acid (6 cents per pound), . . . . . . . . | .168 |

*6. Conclusions.*

1. The nutritive ratio of the feed in 1889 varied from 1 : 4.70 to 1 : 6.57, with an average of 1 : 5.88 ; it varied in 1890 from 1 : 4 64 to 1 : 6.25, with an average of 1 : 5.25.

2. The amount of fat in the milk varied, during the year 1889, from 3.90 per cent. to 4.72 per cent., average 4.39 per cent. In 1890 it varied from 4.38 per cent. to 4.99 per cent , with an average of 4.63 per cent.

3. The total solids varied, in 1889, from 13.82 per cent. to 14.49 per cent., average 14.12 per cent. In 1890 it ran from 13.37 per cent. to 14.65 per cent., average 13.88 per cent.

4. Total cost of feed for one quart of cream amounts, in 1889, to 14.09 cents, and in 1890 to 13.75 cents.

5. Net cost of feed for one quart of cream amounts, in 1889, to 6.09 cents, and in 1890 to 6.05 cents.

6. The value received for one space of cream varied, in 1889, from 3 to 4 cents, with an average of 3.43 cents. In 1890 it varied from 2.80 to 4 cents, with an average of 3.38 cents, which amounts, per quart, in 1889 to 11.69 cents, and in 1890 to 11.46 cents.

7. The quantity of milk, in quarts, required to produce one space of cream, in 1889, amounted to 1.63, and 1.62 in 1890, or 5.54 quarts of whole milk to produce one quart of cream in 1889, and 5.49 quarts in 1890.

8. The net cost of feed per quart of cream averages, in 1889, 6.9 cents, and in 1890 6.05 cents. We received per quart of cream, in 1889, 11.69 cents, and in 1890 11.46 cents, thereby securing a profit of 4.79 cents in 1889, and 5.41 cents in 1890.

From these statements it appears, as has already been claimed in previous reports, that close fodder rations tend to improve the quality of the milk, as well as the condition of the animal.

For further details concerning results in preceding years, see pages 82 to 84, seventh annual report.

Our average statements for the current year apply in each case to only ten months, due to the fact that financial settlement with our local creamery is made two months after cream is furnished.

7. *Creamery Record, 1890. — Analyses of Cream and Butter Fat.*

| Date of Sampling. | Analysis of Cream. | | | Date of Testing. | Analysis of Fat. | | Average Daily Fodder Ration. |
|---|---|---|---|---|---|---|---|
| | Solids. | Fat. | Solids not Fat. | | Volatile Acids. | Non-volatile Acids. | |
| **1890.** | | | | **1890.** | | | |
| January 23, | 27.62 | 18.65 | 8.97 | January 23, | 6.55 | 86.93 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 5 pounds hay, 50 pounds corn ensilage. |
| " 24, | 27.85 | 17.80 | 10.05 | " 24, | 6.63 | 87.10 | |
| " 27, | 25.08 | 17.30 | 7.68 | " 27, | 6.29 | 87.99 | |
| February 3, | 27.52 | 19.20 | 8.32 | February 3, | 6.61 | 88.92 | |
| " 5, | 25.80 | 18.31 | 7.49 | " 5, | 6.53 | 88.18 | |
| " 11, | 27.70 | 18.43 | 9.27 | " 11, | 6.40 | 88.60 | |
| February 24, | 26.47 | 20.96 | 5.51 | February 24, | 6.12 | 89.20 | 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds carrots, 18 pounds fodder corn. |
| " 26, | 25.18 | 16.52 | 8.66 | " 26, | 6.37 | 89.02 | |
| March 3, | 25.10 | 16.62 | 8.48 | March 3, | 6.44 | 88.84 | |
| " 6, | 26.38 | 18.14 | 8.24 | " 6, | 6.38 | 88.92 | |
| " 10, | 25.40 | 17.82 | 7.58 | " 10, | 6.38 | 88.90 | |
| " 11, | 26.10 | 18.24 | 7.86 | " 11, | 6.32 | 88.94 | |
| April 30, | 23.30 | 14.51 | 8.79 | April 30, | 6.57 | 87.10 | 3¼ pounds wheat bran, 3¼ pounds corn meal, 3¼ pounds new-process linseed meal, 20 pounds sugar beets, 15 pounds hay. |
| May 2, | 24.67 | 16.37 | 8.36 | May 2, | 6.44 | 88.31 | |
| " 5, | 26.05 | 17.49 | 8.56 | " 5, | 6.35 | 87.58 | |
| " 7, | 23.93 | 15.00 | 8.93 | " 7, | 6.62 | 88.49 | |
| " 9, | 24.72 | 15.94 | 8.78 | " 9, | 6.45 | 87.39 | |
| " 12, | 24.88 | 14.96 | 9.92 | " 12, | 6.52 | 88.10 | |
| May 20, | 25.12 | 16.90 | 8.22 | June 25, | 6.54 | 88.02 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds sugar beets, 15 pounds hay. |
| " 21, | 25.76 | 17.46 | 8.30 | " 28, | 6.48 | 87.90 | |
| " 23, | 26.69 | 19.18 | 7.51 | July 20, | 7.59 | 84.76 | |
| " 26, | 25.61 | 17.52 | 8.09 | " 22, | 7.96 | 82.04 | |
| " 28, | 24.42 | 16.35 | 8.07 | " 24, | 8.11 | 78.69 | |
| June 6, | 25.76 | 17.95 | 7.81 | July 28, | 7.44 | 83.56 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds rowen. |
| " 9, | 27.70 | 19.86 | 7.84 | August 1, | 7.37 | 85.35 | |
| " 12, | 26.00 | 18.26 | 7.74 | " 3, | 8.06 | 82.99 | |
| " 13, | 26.26 | 18.38 | 7.88 | September 16, | 7.21 | 83.55 | |
| June 17, | 24.53 | 17.93 | 6.60 | September 19, | 6.75 | 86.59 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds old-process linseed meal, 20 pounds rowen. |
| " 18, | 25.54 | 17.67 | 7.87 | " 23, | 6.61 | 86.40 | |

### 7. *Creamery Record, 1890* — Concluded.

| Date of Sampling. | Analysis of Cream. | | | Date of Testing. | Analysis of Fat. | | Average Daily Fodder Ration. |
|---|---|---|---|---|---|---|---|
| | Solids. | Fat. | Solids not Fat. | | Volatile Acids. | Non-volatile Acids. | |
| **1890.** | | | | **1890.** | | | |
| June 27, | 24.30 | 17.34 | 6.96 | September 30, | 6.99 | 86.23 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds new-process linseed meal, 20 pounds rowen. |
| " 29, | 25.59 | 18.01 | 7.58 | - | - | - | |
| July 2, | 24.88 | 17.02 | 7.86 | October 7, | 6.74 | 86.68 | |
| " 3, | 22.94 | 15.97 | 6.97 | " 9, | 6.94 | 86.47 | |
| July 29, | 23.61 | 16.37 | 7.24 | August 7, | 6.78 | 86.61 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds new-process linseed meal, 5 pounds hay, 45 pounds vetch and oats. |
| August 1, | 21.32 | 14.85 | 6.47 | " 11, | 6.78 | 87.14 | |
| August 20, | 26.14 | 18.84 | 7.30 | August 20, | 6.70 | 87.34 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3¼ pounds new-process linseed meal, 5 pounds hay, 50 pounds soja bean. |
| " 27, | 26.44 | 19.07 | 7.27 | " 27, | 6.35 | 87.92 | |
| September 5, | 26.72 | 19.37 | 7.35 | September 5, | 6.25 | 88.40 | |
| September 17, | 24.20 | 16.97 | 7.23 | September 17, | 6.39 | 87.49 | 3¼ pounds corn meal, 3¼ pounds wheat bran, 3½ pounds new-process linseed meal, 20 pounds rowen. |
| " 24, | 22.07 | 14.87 | 7.20 | " 24, | 6.43 | 86.99 | |
| November 7, | 24.12 | 15.46 | 8.66 | November 12, | 7.36 | 86.35 | 3 pounds corn meal, 3 pounds wheat bran, 3 pounds cotton-seed meal, 20 pounds rowen. |
| " 12, | 25.18 | 16.42 | 8.76 | " 12, | 6.94 | 87.04 | |
| " 19, | 25.[illegible] | 15.96 | 9.19 | " 19, | 7.06 | 84.84 | |
| December 2, | - | - | - | December 2, | 6.10 | 84.35 | 3 pounds corn meal, 3 pounds wheat bran, 3 pounds gluten meal, 18 pounds rowen. |
| " 9, | 26.17 | 17.21 | 8.96 | " 9, | 6.48 | 86.45 | |
| " 16, | 21.30 | 13.63 | 7.67 | " 16, | 6.87 | 85.50 | |
| December 24, | 25.95 | 17.29 | 8.66 | December 24, | 6.71 | 85.40 | 3 pounds corn meal, 3 pounds wheat bran, 3 pounds old-process linseed meal, 17 pounds rowen. |
| " 30, | 24.78 | 16.32 | 8.46 | " 30, | 6.61 | 85.28 | |

The analyses of samples taken prior to May 20 were made according to the method of R. W. Moore, as modified by Waller. Those analyzed subsequent to that date were made according to the method of L. F. Nilson, as described in this report, on page 68.

*Method of Milk Analysis.*

*Total Solids.* — Evaporate a known quantity of milk (approximately 5 grams) in a weighed porcelain dish, containing 15 to 20 grams of pure, dry sand, on the water bath until apparently dry, then transfer to the air bath and dry at 100° to 105° C. to a constant weight, weighing at intervals of about an hour. In case of cream, use 2.5 to 3 grams for evaporation.

*Fat.* — Pulverize the sand containing the solids without removing from the dish, subsequently transfer to a filter, and exhaust with anhydrous, alcohol-free ether. Dry the fat obtained on the evaporation of the ether in an air bath at 100° to 105° C. to a constant weight.

*Ash.* — A weighed quantity of milk is evaporated to dryness with a few drops of nitric acid, and burned in a muffle at a low red heat until free from carbon.

*Methods of Butter Analysis.*

(1) *Moisture.* — Two and five-tenths to 3 grams are dried at 100° C. in an air bath.

(2) *Salt.* — Six to 7 grams of the butter are washed into a separatory funnel with hot water, and are well shaken, and allowed to stand until the fat has collected on top; the water is then drawn off, and a fresh quantity added, and shaken up with the butter. This is continued until 200 to 300 cubic centimetres of water have passed through the funnel. The washings are mixed, and made up to 500 cubic centimetres, and the chlorine determined in an aliquot part by means of silver nitrate. From the chlorine the salt is readily calculated.

(3) *Fat.* — Two and five-tenths to 3 grams of the fat freed from salt by the above operation (2), and from water by drying in the air bath, are dissolved in ether, and filtered from the curd into a tared flask. The ether is driven off, and the residual fat dried and weighed. In calculating the per cent., allowance is made for salt and water removed.

(4) *Casein.* — The residue remaining on the filter in (3) is tested for nitrogen by the Kjeldahl method. The factor 6.33 is used in reducing the per cent. of nitrogen found to casein.

*Method for determining Volatile and Non-volatile Fatty Acids (first).*

Directly after receiving the sample of cream from the Cooley cream-setting apparatus, the solids and fat were determined as usual. The cream was churned by vigorous shaking in a bottle, and was washed several times with cold water. The butter was then dissolved in ether, filtered from the curd, and the ether evaporated. About 2.5 grams of fat were placed in a weighed Erlenmeyer flask, the exact weight taken, and the fat saponified by 1 gram of potassium hydrate dissolved in 50 cubic centimetres of 70 per cent. alcohol. Heat is necessary for complete saponification. The alcohol is next driven off by continued heating in a boiling-water bath. The resulting soap is dissolved in 50 cubic centimetres of water, and decomposed by means of 20 cubic centimetres of dilute sulphuric acid (1 part of strong acid to 10 of water); 50 cubic centimetres are then distilled off, using a condenser for that purpose, the distillate passing through a filter. The distillate is titrated with one-tenth-normal sodium hydrate solution (4 grams of pure sodium hydrate per litre of water), 50 cubic centimetres of water are added to the contents of the flask, and an equal quantity distilled off, which is titrated as before. This treatment is continued until .1 cubic centimetre or less of the soda solution is required for neutralization. Phenolphthalein is used as an indicator. The volatile fatty acids are calculated from the sum of the cubic centimetres of soda solution required to neutralize all the distillates, calculating the acid as butyric. After cooling, the liquid remaining in the flask is poured off from the solidified non-volatile fatty acids through the same filter used in filtering the distillates. The solid fatty acids are washed repeatedly with hot water, until all traces of sulphuric acid are removed. The condenser is then washed out with hot alcohol, and the filter exhausted with the same solvent, the washings being collected in the flask. The alcohol is then driven off, the flask and contents dried at 100° C., and weighed, and the per cent. of non-volatile fatty acids calculated. The above method is that of R. W. Moore, as modified by Waller, and described in the "Journal of the American Chemical Society," No. 9, 1889, by R. W. Moore.

*Method for determining Volatile and Non-volatile Fatty Acids contained in Butter (second).*

The sample is prepared by churning the cream in a suitable bottle, washing the butter well with cold water, melting at 50 ° C. and filtering from the curd through a hot-water funnel. The fat is then heated in the air bath until free from water.

The method pursued in the determination of the volatile and non-volatile fatty acids is essentially that described by L. F. Nilson, in "Zeit. f. Anal. Chemie," 28, 2, 176.

Two and eight-tenths cubic centimetres to 2.9 cubic centimetres (approximately 2.5 grams) are measured into a tared Erlenmeyer flask of 250 cubic centimetres capacity, and the exact weight determined. Saponification is accomplished by adding 1 gram of potassium hydrate dissolved in 2 cubic centimetres of water, and 5 cubic centimetres of strong (95 per cent.) alcohol. The flask is provided with a reflux condenser, and heated until saponification is complete. The alcohol is then driven off, the last traces being removed by means of the following device: the flask is provided with a double perforated rubber cork, one hole carrying a glass tube reaching nearly to the bottom of the flask and provided above with a short rubber tube carrying a pinch-cock, the other connected by means of a rubber tube with a suction pump. By alternately opening and closing the pinch-cock while the pump is working, the last traces of alcohol can be readily removed from the soap.

Dissolve the soap thus obtained in 30 cubic centimetres of warm water, decompose with 20 cubic centimetres of a 20 per cent. solution of orthophosphoric acid, distil off the volatile acids through a condenser, filtering the distillate, and titrate with decinormal sodium hydrate, using phenolphthalein as indicator. The volatile acids are expelled from the flask by a current of steam. When the distillate amounts to 500 cubic centimetres, the operation is considered to be complete. The volatile acids are calculated as butyric.

The condenser and connections are rinsed back into the flask with boiling water, and the non-volatile acids washed with hot water, and filtered when cool through the same filter

that was used for the distillate. The washing is continued until no traces of phosphoric acid are left in the distillate. The filter is then exhausted with hot alcohol, allowing the solution to run into the flask. The alcohol is driven off on the water bath, and the non-volatile fatty acids dried at 100° C. in the air bath until they begin to gain weight.

*Dairy Salt, 1890.*

[Sent on from the Cummington Creamery.]

| | Per Cent. | | |
|---|---|---|---|
| | I. | II. | III. |
| Moisture at 100° C., | 0.880 | 0.320 | 0.295 |
| Sodium chloride, | 97.877 | 98.009 | 98.513 |
| Calcium chloride, | 0.016 | 0.013 | 0.010 |
| Calcium sulphate, | 1.108 | 1.644 | 1.160 |
| Magnesium chloride, | 0.010 | 0.014 | 0.012 |
| Magnesium oxide, | 0.007 | – | – |
| Insoluble matter, | 0.102 | 0.020 | 0.010 |

*Dairy Salt, 1890.*

[I. and II. sent on from Amherst, Mass.; III. and IV. sent on from Northampton, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 0.235 | 0.200 | 0.855 | 0.565 |
| Sodium chloride, | 98.563 | 98.575 | 98.891 | 97.935 |
| Calcium sulphate, | 1.137 | 1.185 | 0.906 | 1.376 |
| Calcium chloride, | 0.045 | 0.029 | 0.293 | 0.097 |
| Magnesium chloride, | 0.020 | 0.007 | 0.055 | 0.027 |
| Magnesium oxide, | – | 0.004 | – | – |
| Insoluble matter, | – | – | – | – |

A good dairy salt ought to be of a uniform, fine granulation, of a white color, free from colored specks, free from any odor, of a pure saline test and of a neutral reaction. The chlorides of calcium and magnesia should not exceed one-tenth of one per cent.

## II. — Feeding Experiments with Lambs, 1890.

The feeding experiments which are briefly described within a few subsequent pages are the first of a series devised for the purpose of ascertaining the cost of feed, when fattening lambs, by means of winter fodder rations, for the meat market.

The selection of animals, with reference to breeds best adapted for our purpose, was controlled by the temporary supply of our local market. Six lambs, three ewes and three wethers, bought of a farmer in our vicinity, Sept. 4, 1889, served for our observations. They were grades of a somewhat doubtful parentage; five showed some of the characteristics of Hampshire Downs, and one of Merinos. Each animal occupied, during the entire period of observation, a separate pen. They were shorn before being weighed, at the beginning of the experiment.

The daily diet of the entire lot consisted, during the first week, of rowen (dried second cut of grass lands). They were subsequently treated in two divisions, each comprising three animals. This division was made for the purpose of comparing the effect of two distinctly different daily fodder rations on the financial results of the operation. Division I. (Nos. 1–3) received a daily diet much richer in nitrogenous food constituents than the one adopted for Division II. (Nos. 4–6). This circumstance was brought about by feeding to the first division as grain feed a mixture of wheat bran and of gluten meal, and to the second division one consisting of a liberal proportion of corn meal, with some wheat bran and gluten meal. The coarse portion of the daily feed was in both cases essentially the same; namely, either rowen, or rowen and corn ensilage, or corn ensilage alone. It was cut before being mixed with the grain feed, when fed. The daily fodder ration was divided into two equal parts, and fed respectively in the morning and in the evening. The amount of feed left unconsumed, if any, was collected each morning and deducted from the daily ration offered the preceding day for consumption.

The observations in case of the first division of lambs (Nos. 1–3) were continued for 152 successive days (Sept.

5, 1889, to Feb. 4, 1890), while in case of the second division (Nos. 4–6) they were extended to March 18, 1890, and lasted thus for 194 consecutive days. Low rate of increase in live weight and local market condition advised the extension of the trial in the latter case.

The three lambs of the first division gained within 152 days, in live weight, in the aggregate $107\frac{1}{2}$ pounds, or each individual on an average $35\frac{5}{6}$ pounds; while those of the second division (Nos. 4–6) gained during 194 days, in the aggregate, only 86 pounds, or each individual on an average $28\frac{2}{3}$ pounds.

Some of the essential points of interest in the experiment here under discussion are stated in some subsequent pages, under the following headings: —

1. Weight of lambs.
2. Cost of lambs.
3. Character and cost of feed consumed.
4. Gain in live weight during the observation.
5. Financial statement.
6. Conclusion.
7. Detailed statement of feeding record.

## *1. Weight of Lambs.*

The aggregate live weight of six lambs when bought amounted to $450\frac{1}{2}$ pounds.

The wool secured before the beginning of the feeding experiments amounted to $22\frac{1}{4}$ pounds.

| | Live Weights when bought. | Wool removed. | Live Weights at the Beginning of Trial. |
|---|---|---|---|
| 1, . . | 82.50 pounds. | 3.50 pounds. | 79.00 pounds (wether). |
| 2, . . | 69.50 pounds. | 3.50 pounds. | 66.00 pounds (ewe). |
| 3, . . | 75.00 pounds. | 4.25 pounds. | 70.75 pounds (ewe). |
| 4, . . | 71.00 pounds. | 3.50 pounds. | 67.50 pounds (ewe). |
| 5, . . | 70.00 pounds. | 3.75 pounds. | 66.25 pounds (wether). |
| 6, . . | 82.50 pounds. | 3.75 pounds. | 78.75 pounds (wether). |
| | 450.50 pounds. | 22.25 pounds. | 428.25 pounds. |

Division I. consisted of lambs Nos. 1–3; its aggregate live weight was 215.75 pounds at the beginning of the experiment.

Division II. consisted of lambs Nos. 4–6; its aggregate live weight at the beginning of the experiment was 212.50 pounds.

### 2. *Cost of Lambs.*

The entire lot was bought at six cents per pound of live weight, and the sum paid for 450.5 pounds of the original weight amounted to $27.03.

The wool secured before the beginning of the feeding trial, which amounted to 22.25 pounds, was returned at 23 cents per pound. The sum realized by that transaction was $5.12. Allowing the deduction of $5.12 on the first cost of the lambs, which was $27.03, it will be found that their actual cost at the beginning of the experiment was but $21.91, or 5.12 cents per pound of live weight. The live weight without the removed wool was 428.25 pounds.

*Division I.*

| | | | |
|---|---|---|---|
| 1. | 79.00 pounds of live weight, at 5.12 cents, | $4 05 | $11 01 |
| 2. | 66.00 pounds of live weight, at 5 12 cents, | 3 38 | |
| 3. | 70.00 pounds of live weight, at 5.12 cents, | 3 58 | |

*Division II.*

| | | | |
|---|---|---|---|
| 4. | 67 00 pounds of live weight, at 5 12 cents, | $3 43 | $10 85 |
| 5. | 66.25 pounds of live weight, at 5.12 cents, | 3 39 | |
| 6. | 78.75 pounds of live weight, at 5.12 cents, | 4 03 | |

### 3. *Character and Cost of the Feed consumed.*

To secure a normal and uniform condition of the animals selected for a comparative test of different fodder rations, with reference to their influence on the financial results of the operation, nothing but rowen was fed to the entire lot for ten days preceding the experiment (September 4 to September 16). Subsequently a division of animals was made. Three lambs, 1–3, were fed with daily rations richer in digestible nitrogenous food constituents than those fed to the remaining number, 4–6.

The daily feed of the first division (1–3) contained on an average from 4.5 to 5.5 parts of digestible non-nitrogenous

food constituents to one part of digestible nitrogenous food constituents, 1 : 4.5 to 1 : 5.5.

The daily diet of the second division (4–6) contained, during a corresponding period of the feeding experiment, one part of digestible nitrogenous food constituents to from 6.99 to 7.3 parts of digestible non-nitrogenous food constituents, 1 : 6.99 to 1 : 7.3. Subsequently a diet similar to that adopted for the first division was substituted.

*Fodder Combinations used in Division I. (1–3).*

The daily quantity of the subsequently stated fodder rations was regulated by the appetite of each animal.

*a.* September 16 to September 30 : —

Two pounds of rowen, 1 pound of a mixture consisting of wheat bran, 2 weight parts; gluten meal, 1 weight part.

Nutritive ratio, 1 : 4.75.

*b.* October 1 to December 31 : —

Two pounds of rowen, 1 pound of a mixture consisting of wheat bran and gluten meal, equal weights.

Nutritive ratio, 1 : 4.55.

*c.* January 2 to January 20 : —

One pound of rowen, 3½ pounds of corn ensilage, 1 pound of the same grain mixture as in ration *b.*

Nutritive ratio, 1 : 5.09.

*d.* January 21 to February 3 : —

Seven pounds of corn ensilage, 1 pound of grain mixture as in ration *b.*

Nutritive ratio, 1 : 5.5.

*Cost of Above Fodder Rations for Weights stated.*

| | *a.* | *b.* | *c.* | *d.* |
|---|---|---|---|---|
| Total cost of feed consumed (cents), . . | 2.45 | 2.51 | 2.24 | 1.97 |
| Manurial value obtainable (cents), . . | 1 13 | 1 15 | 1.10 | 1.04 |
| Net cost of feed (cents), . . . . . | 1.32 | 1.36 | 1 14 | 0.93 |

*Fodder Combinations used in Division II. (4–6).*

*a.* September 16 to December 31 : —

Two pounds of rowen, ½ pound of a mixture consisting of corn meal, 10 weight parts; wheat bran, 2 weight parts; gluten meal, 1 weight part.

Nutritive ratio, 1 : 7.00.

*b.* January 2 to January 20 : —

One pound of rowen, $3\frac{1}{2}$ pounds of corn ensilage, $\frac{1}{2}$ pound of the same grain mixture as in preceding ration *a*.

Nutritive ratio, 1 : 7.3.

*c.* February 4 to February 15 : —

Six pounds of corn ensilage, 1 pound of a mixture consisting of wheat bran and gluten meal, equal weights.

Nutritive ratio, 1 : 5.7.

*d.* February 18 to March 17 : —

One and one-half pounds of corn fodder, 1 pound of a mixture the same as in ration c.

Nutritive ratio, 1 : 4.88.

*Cost of Fodder Rations used in Division II:*

| | *a.* | *b.* | *c.* | *d.* |
|---|---|---|---|---|
| Total cost of feed consumed (cents), | 1.98 | 1.71 | 1.83 | 1.56 |
| Manurial value obtainable (cents), | 0.71 | 0.50 | 0.97 | 0.89 |
| Net cost of feed (cents), | 1.27 | 1.21 | 0.86 | 0.67 |

The customary deduction of twenty per cent. of the manurial value of the feed consumed is adopted in the above valuation. Net cost of feed represents its first cost, or local market value, less eighty per cent. of the market value of its manurial constituents.

*Cost of Fodder Articles used in the Experiment.*

| | |
|---|---|
| Rowen, per ton, | $15 00 |
| Corn ensilage, per ton, | 2 75 |
| Corn meal, per ton, | 19 00 |
| Wheat bran, per ton, | 17 00 |
| Gluten meal, per ton. | 23 00 |

### 4. *Gain in Live Weight during the Experiment.*

*Division I. (1–3). Time of Observation extended over 152 Days.*

| | Live Weight at the Beginning of the Experiment (Pounds). | Live Weight at the Time of Killing before shearing (Pounds). | Gain in Live Weight during the Experiment (Pounds). |
|---|---|---|---|
| One, | 79.00 | 118.25 | 39.25 |
| Two, | 66.00 | 98.50 | 32.50 |
| Three, | 70.75 | 106.50 | 35.75 |
| | 215.75 | 323.25 | 107.50 |

*Division II. (4–6). Time of Observation extended over 194 Days.*

| | Live Weight at the Beginning of the Experiment (Pounds). | Live Weight at the Time of Killing before shearing (Pounds). | Gain in Live Weight during the Experiment (Pounds). |
|---|---|---|---|
| Four, . . . . . . | 67.50 | 102.50 | 35.00 |
| Five, . . . . . . | 66.25 | 86.50 | 20.50 |
| Six, . . . . . . | 78.75 | 109.50 | 30.75 |
| | 212.50 | 298.50 | 86.25 |

Division I., entire lot gained in live weight on an average per day, 0.706 pounds.

Division II., entire lot gained in live weight on an average per day, 0.445 pounds.

*The Amount of Raw Wool secured after the Close of the Experiments. Division I. (1–3).*

| | Live Weight, with Wool. | Live Weight after shearing. | Amount of Wool obtained. | |
|---|---|---|---|---|
| | Pounds. | Pounds. | Pounds. | Ounces. |
| One, . . . . . . | 118.25 | 114.38 | 3 | 14 |
| Two, . . . . . | 98.50 | 94.60 | 3 | 15 |
| Three, . . . . . | 106.50 | 102.00 | 4 | 8 |
| | 323.25 | 310.98 | 12 | 5 |

*Division II. (4–6).*

| | Live Weight, with Wool. | Live Weight after shearing. | Amount of Wool obtained. | |
|---|---|---|---|---|
| | Pounds. | Pounds. | Pounds. | Ounces. |
| Four, . . . . . | 102.50 | 99.25 | 3 | 4 |
| Five, . . . . . . | 86.50 | 82.00 | 4 | 8 |
| Six, . . . . . . | 109.50 | 105.00 | 4 | 8 |
| | 298.50 | 286.25 | 12 | 4 |

Division I. yielded 12 pounds, 5 ounces of wool.

Division II. yielded 12 pounds, 4 ounces of wool.

The former is the result of 152 days of growth, and the latter that of 194 days. Lamb No. 5 is a Merino grade; the remainder are Hampshire Down grades.

### 5. *Financial Statement.*

The wool was sold at 23 cents per pound, the pelts brought $12\frac{1}{2}$ cents each.

#### *Division I. (1–3).*

The difference between the live weights of the animals at the close of the experiment, after shearing, and the dressed lambs, when sold, amounted on an average to 44.3 per cent.

*Yield Dressed Weights.*

| | | |
|---|---|---|
| 1. | 66 pounds, at 11 cents per pound, | $7 26 |
| 2. | 54 pounds, at 11 cents per pound, | 5 94 |
| 3. | 60 pounds, at 11 cents per pound, | 6 60 |
| | 180 pounds, | $19 80 |

#### *Division II. (4–6).*

The difference between the live weights of the animals at the close of the experiment, after shearing, and the dressed lambs, when sold, amounted on an average to 46.3 per cent.

*Yield Dressed Weights.*

| | | |
|---|---|---|
| 4. | 54 pounds, at 11 cents per pound, | $5 94 |
| 5. | 46 pounds, at 11 cents per pound, | 5 06 |
| 6. | 60.50 pounds, at 11 cents per pound, | 6 65 |
| | 160.50 pounds, | $17 65 |

#### *Division I.*

| | 1. | 2. | 3. | |
|---|---|---|---|---|
| Cost of lamb, | $4 05 | $3 38 | $3 58 | $22 78 |
| Cost of feed consumed, | 4 58 | 3 11 | 4 08 | |
| | $8 63 | $6 49 | $7 66 | |
| Value received for meat, | $7 26 | $5 94 | $6 60 | $28 70 |
| Value received for wool and pelt, | 1 02 | 1 04 | 1 17 | |
| Value of obtainable manure, | 2 19 | 1 52 | 1 96 | |
| | $10 47 | $8 50 | $9 73 | |

Difference in favor, $5.92.

*Division II.*

| | 4. | 5. | 6. | |
|---|---|---|---|---|
| Cost of lamb, | $3 43 | $3 39 | $4 03 | $22 34 |
| Cost of feed consumed, | 4 64 | 3 03 | 3 82 | |
| | $8 07 | $6 42 | $7 85 | |
| Value received for meat, | $5 94 | $5 06 | $6 65 | $25 37 |
| Value received for wool and pelt, | 0 89 | 1 17 | 1 17 | |
| Value of obtainable manure, | 1 71 | 1 23 | 1 55 | |
| | $8 54 | $7 46 | $9 37 | |

Difference in favor, $3.03.

## 6. *Conclusions.*

1. The well-established superior feeding effect of a daily diet rich in digestible nitrogenous food constituents, when raising lambs for the meat market, is shown in a marked degree in Division I., as compared with those in Division II.

2. The good services of the particular fodder rations used in case of the first division of lambs is shown by a fair rate of increase in live weight.

3. Corn ensilage as a substitute in part for rowen has given very satisfactory results.

4. The profit obtained with reference to both divisions of lambs is due to the commercial value of the fertilizing constituents contained in the obtainable manure. This value amounts in the case of the first division of lambs to $5.67. To appreciate this value properly, it needs to be considered that, in determining the financial results of the experiment, all home-raised fodder articles are counted on the basis of their retail selling price in our vicinity. Sheep are known to produce one of the best home-made manures.

The decidedly beneficial influence of a rational and liberal system of stock-feeding on the financial results of a mixed farm management cannot find *its full expression* in the mere presentation of the results of a feeding experiment, however carefully the matter may be arranged.

## 7. *Detailed Statement of Feeding Record.*

*Sheep No. 1.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | Pounds of Dry Matter in Daily Fodder consumed. | Gain in Live Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound of Live Weight. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Gluten Meal. | Rowen. | Corn Ensilage. | | | | | |
| **1889-1890.** | | | | | | | | | |
| Sept. 17 to Sept. 30, . | 0.74 | 0.37 | 1.93 | – | 2.67 | 0.32 | 8.34 | 1 : 4.74 | 86.00 |
| Oct. 1 to Dec. 3, . | 0.69 | 0.69 | 2.52 | – | 3.43 | 0.26 | 13.19 | 1 : 4.55 | 96.75 |
| Dec. 17 to Dec 31, . | 0.75 | 0.75 | 2.87 | – | 3.84 | 0 30 | 12.80 | 1 : 4.59 | 111.00 |
| Jan. 2 to Jan. 20, . | 0.77 | 0.77 | 1.54 | 4.05 | 3.82 | 0.26 | 14.69 | 1 : 5.09 | 114.50 |
| Jan. 21 to Feb. 3, . | 0.63 | 0.63 | – | 6.29 | 2.84 | 0.02 | 142.00 | 1 : 5.52 | 117.50 |

*Total Amount of Feed consumed from Sept. 5, 1889, to Feb. 3, 1890.**

| | Dry Matter (Pounds). | Cost. | Fertilizer Value. |
|---|---|---|---|
| 104.57 pounds wheat bran, . . . . | 94.88 | $0 89 | $0 71 |
| 97.07 pounds gluten meal, . . . . | 87.56 | 1 12 | 0 79 |
| 310.00 pounds rowen, . . . . . | 268.05 | 2 33 | 1 07 |
| 178.50 pounds corn ensilage, . . . . | 48.42 | 0 24 | 0 15 |
| | 498.91 | $4 58 | $2 72 |

* Includes the feed during the 12 days preceding the experiment proper.

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, . . | 79.00 |
| Live weight at time of killing, . . . . . . . . . | 118.25 |
| Live weight gained during experiment, . . . . . . | 39.25 |
| Average gain in weight per day, . . . . . . . . | 0.25 |
| Dressed weight of animal, . . . . . . . . . . | 66.00 |

Loss in weight by dressing, . . . 52.25 pounds, or 44.19 per cent.
Pounds of dry matter fed to produce 1 pound of live weight, 12.71
Cost of feed per pound of live weight gained, . . . . 11.67 cents
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, . . . . . . . . 6.11 cents.

*7. Detailed Statement of Feeding Record* — Continued.

*Sheep No. 1.*

| FEEDING PERIODS. | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Nutritive Ratio of Feed. | Live Weight of Animal at Beginning of Period (Pounds). | Live Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 17 to Sept. 30, . | 10.33 | 5.17 | 27.00 | – | 1 : 4.74 | 84 00 | 88.50 | 0.32 |
| Oct. 1 to Dec. 3, . | 44.31 | 44.31 | 161.00 | – | 1 : 4.55 | 88.50 | 105.00 | 0.26 |
| Dec. 17 to Dec. 31, . | 11.25 | 11.25 | 43.00 | – | 1 : 4.59 | 108.00 | 112.50 | 0.30 |
| Jan. 2 to Jan. 20, . | 14.63 | 14.63 | 29 25 | 77.00 | 1 : 5.09 | 113.00 | 118.00 | 0.26 |
| Jan. 21 to Feb. 3, . | 8.88 | 8.88 | – | 88.00 | 1 : 5.52 | 118.00 | 118.25 | 0.02 |

*Total Amount of Feed consumed from Sept. 17, 1889, to Feb. 3, 1890.*

| | Pounds. |
|---|---|
| 99.90 pounds wheat bran, equal to dry matter, . . . . | 90.64 |
| 94.74 pounds gluten meal, equal to dry matter, . . . . | 85.46 |
| 281.00 pounds rowen, equal to dry matter, . . . . . | 242.98 |
| 178.50 pounds corn ensilage, equal to dry matter, . . . . | 48.42 |
| Total amount of dry matter, . . . . . . . . | 467.50 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, . . . | 84.00 |
| Live weight of animal at time of killing, . . . . . . | 118.25 |
| Live weight gained during experiment, . . . . . . | 34.25 |
| Dressed weight at time of killing, . . . . . . . | 66.00 |

Loss in weight by dressing, . . 52.25 pounds or 44.19 per cent.

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 99.90 pounds wheat bran, at $17.00 per ton, . . . . . | $0 85 |
| 94.74 pounds gluten meal, at $23.00 per ton, . . . . . | 1 09 |
| 281.00 pounds rowen, at $15.00 per ton, . . . . . . | 2 11 |
| 178.50 pounds corn ensilage, at $2.75 per ton, . . . . . | 0 24 |
| | $4 29 |

13.65 pounds of dry matter yielded 1 pound of live weight.
Cost of feed for production of 1 pound of live weight, 12.52 cents.

7. *Detailed Statement of Feeding Record* — Continued.

*Sheep No. 2.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | Pounds of Dry Matter in Daily Fodder consumed. | Gain in Live Weight per Day (Pounds). | Pounds of Dry Matter produced one Pound of Live Weight. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| | Wheat Bran. | Gluten Meal. | Rowen. | Corn Ensilage. | | | | | |
| **1889-1890.** | | | | | | | | | |
| Sept. 17 to Sept. 30, | 0.61 | 0.31 | 1.43 | - | 2.07 | 0.50 | 4.14 | 1:4.64 | 70.00 |
| Oct. 1 to Dec. 3, | 0.51 | 0.51 | 1.66 | - | 2.36 | 0.22 | 10.73 | 1:4.45 | 82.75 |
| Dec. 17 to Dec. 31, | 0.51 | 0.51 | 1.23 | - | 1.98 | 0.12 | 16.50 | 1:4.20 | 90.25 |
| Jan. 2 to Jan. 20, | 0.50 | 0.50 | 0.58 | 2.92 | 2.19 | 0.29 | 7.55 | 1:5.01 | 95.00 |
| Jan. 21 to Feb. 3, | 0.58 | 0.58 | - | 4.79 | 2.35 | 0.11 | 21.36 | 1:5.24 | 98.00 |

*Total Amount of Feed consumed from Sept. 5, 1889, to Feb. 3, 1890.**

| | Dry Matter (Pounds). | Cost. | Fertilizer Value. |
|---|---|---|---|
| 79.61 pounds wheat bran, | 72.23 | $0 68 | $0 54 |
| 72.99 pounds gluten meal, | 65.84 | 0 84 | 0 59 |
| 188.00 pounds rowen, | 162.56 | 1 41 | 0 65 |
| 130.75 pounds corn fodder, | 35.36 | 0 18 | 0 11 |
| | 335.99 | $3 11 | $1 89 |

* Includes the feed during the 12 days preceding the experiment proper.

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 66.00 |
| Live weight at time of killing, | 98.50 |
| Live weight gained during experiment, | 32.50 |
| Average gain in weight per day, | 0.21 |
| Dressed weight of animal, | 54.00 |
| Loss in weight by dressing, 44.50 pounds, or 45.18 per cent. | |
| Pounds of dry matter fed to produce 1 pound of live weight, | 10.34 |
| Cost of feed per pound of live weight gained, | 9.57 cents. |
| Net cost of feed per pound gained after deducting 20 per cent. of manurial value, | 4.92 cents. |

7. *Detailed Statement of Feeding Record* — Continued.

*Sheep No. 2.*

| FEEDING PERIODS. | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Nutritive Ratio of Feed. | Live Weight of Animal at Beginning of Period (Pounds). | Live Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 17 to Sept. 30, . | 8.56 | 4.28 | 20.00 | - | 1.4.64 | 67.50 | 74.50 | 0.50 |
| Oct. 1 to Dec. 3, . | 32.63 | 32.63 | 106.00 | - | 1:4.45 | 74.50 | 88.50 | 0.22 |
| Dec. 17 to Dec. 31, . | 7.63 | 7.63 | 18.50 | - | 1.4.20 | 88.50 | 90.50 | 0.12 |
| Jan. 2 to Jan. 20, . | 9.50 | 9.50 | 11.00 | 55.50 | 1:5.01 | 91.50 | 97.00 | 0.29 |
| Jan. 21 to Feb. 3, . | 8.12 | 8.12 | - | 67.00 | 1:5.24 | 97.00 | 98.50 | 0.11 |

*Total Amount of Feed consumed from Sept. 17, 1889, to Feb. 3, 1890.*

| | Pounds. |
|---|---|
| 74.94 pounds wheat bran, equal to dry matter, . . . . | 67.99 |
| 70.66 pounds gluten meal, equal to dry matter, . . . | 63.74 |
| 168.00 pounds rowen, equal to dry matter, . . . . | 145.27 |
| 126.50 pounds corn ensilage, equal to dry matter, . . . | 35.36 |
| Total amount of dry matter, . . . . . . . | 312.36 |

| | Pounds |
|---|---|
| Live weight of animal at beginning of experiment, . . . | 67.50 |
| Live weight at time of killing, . . . . . . . . | 98.50 |
| Live weight gained during experiment, . . . . . | 31.00 |
| Dressed weight at time of killing, . . . . . . | 54.00 |

Loss in weight by dressing, . . 44.50 pounds, or 45.18 per cent.

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 74.94 pounds wheat bran, at $17.00 per ton, . . . . | $0 64 |
| 70.66 pounds gluten meal, at $23 00 per ton, . . . . | 0 81 |
| 168.00 pounds rowen, at $15.00 per ton, . . . . . | 1 26 |
| 130.75 pounds corn ensilage, at $2.75 per ton, . . . . | 0 18 |
| | $2 89 |

10.08 pounds of dry matter yielded 1 pound of live weight.
Cost of feed for the production of 1 pound of live weight, 9.32 cents.

7. *Detailed Statement of Feeding Record* — Continued.

*Sheep No. 3.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. Wheat Bran. | Gluten Meal. | Rowen. | Corn Ensilage. | Pounds of Dry Matter in Daily Fodder consumed. | Gain in Live Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound of Live Weight. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | | |
| Sept. 17 to Sept. 30, . | 0.71 | 0.35 | 1.96 | - | 2.65 | 0.30 | 8.83 | 1 : 4.78 | 79.25 |
| Oct. 1 to Dec. 3, . | 0.64 | 0.64 | 2.37 | - | 3.21 | 0.17 | 18.88 | 1 : 4.67 | 88.75 |
| Dec. 17 to Dec. 31, . | 0.63 | 0.63 | 2.00 | - | 2.87 | 0.30 | 9.57 | 1 : 4.42 | 97.25 |
| Jan. 2 to Jan. 20, . | 0.62 | 0.62 | 1.08 | 3.07 | 2.88 | 0.26 | 11.08 | 1 : 4.97 | 100.75 |
| Jan. 21 to Feb. 3, . | 0.58 | 0.58 | - | 5.02 | 2.41 | 0.18 | 13.39 | 1 : 5.29 | 105.00 |

*Total Amount of Feed consumed from Sept. 5, 1889, to Feb. 3, 1890.**

| | Dry Matter (Pounds). | Cost. | Fertilizer Value. |
|---|---|---|---|
| 95.79 pounds wheat bran, . . . . | 86.91 | $0 81 | $0 65 |
| 88.49 pounds gluten meal, . . . . | 79.82 | 1 02 | 0 72 |
| 274.25 pounds rowen, . . . . . | 237.14 | 2 06 | 0 95 |
| 149.00 pounds corn ensilage, . . . | 40.23 | 0 19 | 0 12 |
| | 444.10 | $4 08 | $2 44 |

* Includes the feed during 12 days preceding the experiment proper.

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, . . . . | 71.00 |
| Live weight at time of killing, . . . . . . . . . . | 106.50 |
| Live weight gained during experiment, . . . . . . . | 35.50 |
| Average gain in weight per day, . . . . . . . . . | 0.23 |
| Dressed weight of animal, . . . . . . . . . . | 60.00 |

Loss in weight by dressing, . . 46.50 pounds, or 43.66 per cent.
Pounds of dry matter fed to produce 1 pound of live weight, . 12.51
Cost of feed per pound of live weight gained, . . . 11.49 cents.
Net cost of feed per pound gained after deducting 20 per cent. of manurial value, . . . . . . . . . 6.00 cents.

*7. Detailed Statement of Feeding Record* — Continued.

*Sheep No. 3.*

| FEEDING PERIODS. | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Nutritive Ratio of Feed. | Live Weight of Animal at Beginning of Period (Pounds). | Live Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 17 to Sept. 30, . | 9.92 | 4.96 | 27.50 | – | 1 : 4.78 | 78.25 | 82.50 | 0.30 |
| Oct. 1 to Dec. 3, . | 41.06 | 41.06 | 151.50 | – | 1 : 4.67 | 82.50 | 93.50 | 0.17 |
| Dec. 17 to Dec. 31, . | 9.50 | 9.50 | 30.00 | – | 1 : 4.42 | 95.00 | 99.50 | 0.30 |
| Jan. 2 to Jan. 20, . | 11.87 | 11.87 | 20.50 | 58.25 | 1 : 4.97 | 99.00 | 104.00 | 0.26 |
| Jan. 21 to Feb. 3, . | 8.12 | 8.12 | – | 70.25 | 1 : 5.29 | 104.00 | 106.50 | 0.18 |

*Total Amount of Feed consumed from Sept. 17, 1889, to Feb. 3, 1890.*

| | Pounds. |
|---|---|
| 91.12 pounds wheat bran, equal to dry matter, . . . . . | 82.67 |
| 86.16 pounds gluten meal, equal to dry matter, . . . . | 77.72 |
| 252.25 pounds rowen, equal to dry matter, . . . . . | 218.12 |
| 149.00 pounds corn ensilage, equal to dry matter, . . . . | 40.23 |
| Total amount of dry matter, . . . . . . . . | 418.74 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, . . . . | 78.25 |
| Live weight at time of killing, . . . . . . . . | 106.50 |
| Live weight gained during experiment, . . . . . . | 28.25 |
| Dressed weight at time of killing, . . . . . . . | 60.00 |

Loss in weight by dressing, . . . 46.50 pounds, or 43.66 per cent.

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 91.12 pounds wheat bran, at $17.00 per ton, . . . . . | $0 77 |
| 86.16 pounds gluten meal, at $23.00 per ton, . . . . . | 0 99 |
| 252.25 pounds rowen, at $15.00 per ton, . . . . . . | 1 89 |
| 149.00 pounds corn ensilage, at $2.75 per ton, . . . . . | 0 20 |
| | $3 85 |

14.82 pounds of dry matter yielded 1 pound of live weight.

Cost of feed for the production of 1 pound of live weight, 13.59 cents.

## 7. *Detailed Statement of Feeding Record* — Continued.

### *Sheep No. 4.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | Pounds of Dry Matter in Daily Fodder consumed. | Gain in Live Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound of Live Weight. | Nutritive Ratio. | Average Weight of Animal (Pounds) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corn Meal. | Wheat Bran. | Gluten Meal. | Rowen. | Corn Ensilage. | Corn Fodder. | | | | | |
| **1889-1890.** | | | | | | | | | | | |
| Sept. 17 to Dec. 3, | 0.54 | 0.11 | 0.05 | 2.56 | – | – | 2.84 | 0.13 | 21.85 | 1 6.99 | 82.00 |
| Dec. 17 to Dec. 31, | 0.58 | 0.12 | 0.06 | 1.97 | – | – | 2.37 | 0.02 | 118.50 | 1 7 01 | 89 75 |
| Jan. 2 to Jan. 20, | 0.58 | 0.12 | 0.06 | 1.16 | 2.05 | – | 2.22 | 0.14 | 15.86 | 1 7.30 | 91.50 |
| Feb. 4 to Feb. 15, | – | 0.50 | 0.50 | – | 5.67 | – | 2.43 | 0.33 | 7.36 | 1 : 5.76 | 98.50 |
| Feb. 18 to Mar. 17, | – | 0.55 | 0.55 | – | – | 1.59 | 2.27 | 0.03 | 75.67 | 1 : 4.88 | 101.50 |

*Total Amount of Feed consumed from Sept. 5, 1889, to March 17, 1890.**

| | Dry Matter (Pounds). | Cost. | Fertilizer Value. |
|---|---|---|---|
| 78.21 pounds corn meal, . . . . . | 69.09 | $0 75 | $0 25 |
| 41.99 pounds wheat bran, . . . . | 38.10 | 0 36 | 0 28 |
| 32.25 pounds gluten meal, . . . . | 29.09 | 0 37 | 0 26 |
| 305.50 pounds rowen, . . . . . | 264.16 | 2 70 | 1 06 |
| 185.75 pounds corn ensilage, . . . . | 50.25 | 0 26 | 0 14 |
| 54.00 pounds corn fodder, . . . . | 42 23 | 0 20 | 0 14 |
| | 492.92 | $4 64 | $2 13 |

* Includes the feed during 12 days preceding the experiment proper.

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, . . . . | 67 50 |
| Live weight at time of killing, . . . . . . . . . . | 102.25 |
| Live weight gained during experiment, . . . . . . . | 34.75 |
| Average gain in weight per day, . . . . . . . | 0.18 |
| Dressed weight of animal, . . . . . . . . . . | 54.00 |
| Loss in weight by dressing, . . . 48.25 pounds, or 47.19 per cent. | |
| Pounds of dry matter fed to produce 1 pound of live weight, . | 14.19 |
| Cost of feed per pound of live weight gained, . . . . | 13.35 cents. |
| Net cost of feed per pound gained after deducting 20 per cent. of manurial value, . . . . . . . . | 8.46 cents. |

7. *Detailed Statement of Feeding Record* — Continued.

*Sheep No. 4.*

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Corn Fodder consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Nutritive Ratio of Feed. | Live Weight of Animal at Beginning of Period (Pounds). | Live Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | | | |
| Sept. 17 to Dec. 3, | 41.88 | 4.19 | 8.38 | - | - | 200.00 | 1 : 6.99 | 74.50 | 85.00 | 0.13 |
| Dec. 17 to Dec. 31, | 8.65 | 0.87 | 1.73 | - | - | 29 50 | 1 : 7.01 | 90.00 | 90.25 | 0.02 |
| Jan. 2 to Jan. 20, | 10.96 | 1.10 | 2.19 | 39.00 | - | 22.00 | 1 : 7.30 | 90.00 | 92.75 | 0.14 |
| Feb. 4 to Feb. 15, | - | 6.00 | 6.00 | 68.00 | - | - | 1 : 5.76 | 96.50 | 100.50 | 0.33 |
| Feb. 18 to Mar. 17, | - | 15.50 | 15.50 | - | 44.50 | - | 1 : 4.88 | 101.50 | 102.25 | 0.03 |

*Total Amount of Feed consumed from Sept. 17, 1889, to March 17, 1890.*

| | Pounds. |
|---|---|
| 75.52 pounds corn meal, equal to dry matter, | 66.71 |
| 31.98 pounds gluten meal, equal to dry matter, | 28.85 |
| 41.45 pounds wheat bran, equal to dry matter, | 37.61 |
| 283.50 pounds rowen, equal to dry matter, | 245.14 |
| 185.75 pounds corn ensilage, equal to dry matter, | 50.25 |
| 54.00 pounds corn fodder, equal to dry matter, | 42.23 |
| Total amount of dry matter, | 470.79 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 74.50 |
| Live weight at time of killing, | 102.25 |
| Live weight gained during experiment, | 27.75 |
| Dressed weight at time of killing, | 54.00 |

Loss in weight by dressing, . . . 48 25 pounds, or 47.19 per cent.

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 75.52 pounds corn meal, at $19 00 per ton, | $0 72 |
| 31.98 pounds gluten meal, at $23.00 per ton, | 0 37 |
| 41 45 pounds wheat bran, at $17.00 per ton, | 0 35 |
| 283 50 pounds rowen, at $15.00 per ton, | 2 13 |
| 185.75 pounds corn ensilage, at $2.75 per ton, | 0 26 |
| 54 00 pounds corn fodder, at $7.50 per ton, | 0 20 |
| | $4 03 |

16 97 pounds of dry matter fed yielded 1 pound of live weight.

Cost of feed for the production of 1 pound of live weight, 14 50 cents.

## 7. *Detailed Statement of Feeding Record* — Continued.

### *Sheep No. 5.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | Pounds of Dry Matter in Daily Fodder consumed. | Gain in Live Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound of Live Weight. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corn Meal. | Wheat Bran. | Gluten Meal. | Rowen. | Corn Ensilage. | Corn Fodder. | | | | | |
| **1889-1890.** | | | | | | | | | | | |
| Sept. 17 to Dec. 3, | 0.40 | 0.08 | 0.04 | 1.80 | – | – | 2.02 | 0.12 | 16.83 | 1 : 6.99 | 72.75 |
| Dec. 17 to Dec. 31, | 0.39 | 0.08 | 0.04 | 1.47 | – | – | 1.72 | -0.23 | – | 1 : 7.00 | 75.75 |
| Jan. 2 to Jan. 20, | 0.41 | 0.08 | 0.04 | 0.53 | 2.84 | – | 1.70 | 0.36 | 4.72 | 1 : 8.58 | 79.00 |
| Feb. 4 to Feb. 15, | – | 0.39 | 0.39 | – | 3.50 | – | 1.65 | 0.25 | 6.60 | 1 : 5.37 | 84.25 |
| Feb. 18 to Mar. 17, | – | 0.43 | 0.43 | – | – | 0.93 | 1.52 | -0.02 | – | 1 : 4.53 | 86.75 |

### *Total Amount of Feed consumed from Sept. 5, 1889, to March 17, 1890.**

| | Dry Matter (Pounds). | Cost. | Fertilizer Value. |
|---|---|---|---|
| 59.85 pounds corn meal, . . . . | 52.87 | $0 57 | $0 19 |
| 33.32 pounds wheat bran, . . . | 30.23 | 0 29 | 0 22 |
| 25.42 pounds gluten meal, . . . | 22.93 | 0 29 | 0 20 |
| 203.50 pounds rowen, . . . . | 175.97 | 1 53 | 0 70 |
| 166.00 pounds corn ensilage, . . . | 44.90 | 0 23 | 0 13 |
| 31.50 pounds corn fodder, . . . | 24.74 | 0 12 | 0 08 |
| | 351.64 | $3 03 | $1 52 |

* Includes the feed during 12 days preceding the experiment proper.

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, . . . | 66.25 |
| Live weight at time of killing, . . . . . . . . . | 86.50 |
| Live weight gained during experiment, . . . . . . | 20.25 |
| Average gain in weight per day, . . . . . . . | 0.10 |
| Dressed weight of animal, . . . . . . . . . | 46.00 |
| Loss in weight by dressing, . . . | 40.50 pounds, or 46.82 per cent. |
| Pounds of dry matter fed to produce 1 pound of live weight, . | 17.36 |
| Cost of feed per pound of live weight gained, . . . . | 14.96 cents. |
| Net cost of feed per pound gained after deducting 20 per cent. of manurial value, . . . . . . . | 8.94 cents. |

7. *Detailed Statement of Feeding Record* — Continued.

*Sheep No. 5.*

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Corn Fodder consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Nutritive Ratio of Feed. | Live Weight of Animal at Beginning of Period (Pounds). | Live Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | | | |
| Sept. 17 to Dec. 3, | 31.00 | 3.10 | 6.20 | - | - | 140.50 | 1:6.99 | 66.25 | 75.50 | 0.12 |
| Dec. 17 to Dec. 31, | 5.87 | 0.59 | 1.17 | - | - | 22.00 | 1:7.00 | 77.50 | 74.00 | -0.23 |
| Jan. 2 to Jan. 20, | 7.70 | 0.77 | 1.54 | 54.00 | - | 10.00 | 1:8.58 | 75.00 | 81.75 | 0.36 |
| Feb. 4 to Feb. 15, | - | 4.63 | 4.63 | 42.00 | - | - | 1:5.37 | 83.00 | 86.00 | 0.25 |
| Feb. 18 to Mar. 17, | - | 12.13 | 12.13 | - | 26.00 | - | 1:4.53 | 87.00 | 86.50 | -0.02 |

*Total Amount of Feed consumed from Sept. 17, 1889, to March 17, 1890.*

| | Pounds. |
|---|---|
| 57.16 pounds corn meal, equal to dry matter, | 50.49 |
| 25.15 pounds gluten meal, equal to dry matter, | 22.69 |
| 32.78 pounds wheat bran, equal to dry matter, | 29.74 |
| 182.50 pounds rowen, equal to dry matter, | 157.81 |
| 166.00 pounds corn ensilage, equal to dry matter, | 40.90 |
| 31.50 pounds corn fodder, equal to dry matter, | 24.74 |
| Total amount of dry matter, | 330.37 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 66.25 |
| Live weight at time of killing, | 86.50 |
| Live weight gained during experiment, | 20.25 |
| Dressed weight at time of killing, | 46.00 |

Loss in weight by dressing, . . . 40.50 pounds, or 46.82 per cent.

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 57.16 pounds corn meal, at $19.00 per ton, | $0 54 |
| 25.15 pounds gluten meal, at $23.00 per ton, | 0 29 |
| 32.78 pounds wheat bran, at $17.00 per ton, | 0 28 |
| 182.50 pounds rowen, at $15.00 per ton, | 1 37 |
| 166.00 pounds corn ensilage, at $2.75 per ton, | 0 23 |
| 31.50 pounds corn fodder, at $7.50 per ton, | 0 12 |
| | $2 83 |

16.31 pounds of dry matter fed yielded 1 pound of live weight.
Cost of feed for the production of 1 pound of live weight, 13.98 cents.

7. *Detailed Statement of Feeding Record*—Continued.

*Sheep No. 6.*

| FEEDING PERIODS. | Feed consumed (Pounds) per Day. | | | | | | Pounds of Dry Matter in Daily Fodder consumed. | Gain in Live Weight per Day (Pounds). | Pounds of Dry Matter produced One Pound of Live Weight. | Nutritive Ratio. | Average Weight of Animal (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Corn Meal. | Wheat Bran. | Gluten Meal. | Rowen. | Corn Ensilage. | Corn Fodder. | | | | | |
| **1889-1890.** | | | | | | | | | | | |
| Sept. 17 to Dec. 3, | 0.48 | 0.10 | 0.05 | 2.21 | - | - | 2.47 | 0.17 | 14.53 | 1 : 6.99 | 91.25 |
| Dec. 17 to Dec. 31, | 0.56 | 0.11 | 0.06 | 2.20 | - | - | 2.54 | 0.23 | 11.05 | 1 : 7.00 | 99.50 |
| Jan. 2 to Jan. 20, | 0.48 | 0.10 | 0.05 | 0.97 | 1.89 | - | 1.91 | 0.16 | 11.94 | 1 : 7.90 | 102.00 |
| Feb. 4 to Feb. 15, | - | 0.50 | 0.50 | - | 5.42 | - | 2.37 | 0.21 | 11.29 | 1 : 5.68 | 107.50 |
| Feb. 18 to Mar. 17, | - | 0.55 | 0.55 | - | - | 1.38 | 2.10 | - | - | 1 : 4.70 | 108.00 |

*Total Amount of Feed consumed from Sept. 5, 1889, to March 17, 1890.**

| | Dry Matter (Pounds). | Cost. | Fertilizer Value. |
|---|---|---|---|
| 71.31 pounds corn meal, | 62.99 | $0 68 | $0 23 |
| 40.61 pounds wheat bran, | 36.85 | 0 35 | 0 27 |
| 31.55 pounds gluten meal, | 28.45 | 0 36 | 0 25 |
| 264.50 pounds rowen, | 228.71 | 1 98 | 0 92 |
| 193.50 pounds corn ensilage, | 52.31 | 0 27 | 0 15 |
| 43.50 pounds corn fodder, | 34.40 | 0 17 | 0 11 |
| | 443.71 | $3 81 | $1 93 |

* Includes the feed during 12 days preceding the experiment proper.

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 79.00 |
| Live weight at time of killing, | 109.50 |
| Live weight gained during experiment, | 30.50 |
| Average gain in weight per day, | 0.16 |
| Dressed weight of animal, | 60.50 |
| Loss in weight by dressing, | 49 pounds, or 44.75 per cent. |
| Pounds of dry matter fed to produce 1 pound of live weight, | 14.55 |
| Cost of feed per pound of live weight gained, | 12.49 cents. |
| Net cost of feed per pound gained after deducting 20 per cent. of manurial value, | 7.44 cents. |

7. *Detailed Statement of Feeding Record* — Concluded.

*Sheep No. 6.*

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Corn Ensilage consumed (Pounds). | Total Amount of Corn Fodder consumed (Pounds). | Total Amount of Rowen consumed (Pounds). | Nutritive Ratio of Feed. | Live Weight of Animal at Beginning of Period (Pounds). | Live Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | | | |
| Sept. 17 to Dec. 3, | 37.10 | 3.71 | 7.42 | – | – | 172.00 | 1 : 6.99 | 83.25 | 96.75 | 0.17 |
| Dec. 17 to Dec. 31, | 8.46 | 0.85 | 1.69 | – | – | 33.00 | 1 : 7.00 | 98.00 | 101.50 | 0.23 |
| Jan. 2 to Jan. 20, | 9.13 | 0.91 | 1.83 | 36.00 | – | 18.50 | 1 : 7.90 | 100.50 | 103.50 | 0.16 |
| Feb. 4 to Feb. 15, | – | 6.00 | 6.00 | 65.00 | – | – | 1 : 5.68 | 105.50 | 108.00 | 0.21 |
| Feb. 18 to Mar. 17, | – | 15.50 | 15.50 | – | 38.50 | – | 1 : 4.70 | 109.50 | 109.50 | – |

*Total Amount of Feed consumed from Sept. 17, 1889, to March 17, 1890.*

| | Pounds. |
|---|---|
| 68.62 pounds corn meal, equal to dry matter, | 60.61 |
| 31.28 pounds gluten meal, equal to dry matter, | 28.21 |
| 40.07 pounds wheat bran, equal to dry matter, | 36.36 |
| 242.50 pounds rowen, equal to dry matter, | 209.69 |
| 193.50 pounds corn ensilage, equal to dry matter, | 52.34 |
| 43.50 pounds corn fodder, equal to dry matter, | 34.40 |
| Total amount of dry matter, | 421.61 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 83.25 |
| Live weight at time of killing, | 109.50 |
| Live weight gained during experiment, | 26.25 |
| Dressed weight at time of killing, | 60.50 |
| Loss in weight by dressing, | 49 pounds, or 44.75 per cent. |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 68.62 pounds corn meal, at $19.00 per ton, | $0 65 |
| 31.28 pounds gluten meal, at $23.00 per ton, | 0 36 |
| 40.07 pounds wheat bran, at $17.00 per ton, | 0 34 |
| 242.50 pounds rowen, at $15.00 per ton, | 1 82 |
| 193.50 pounds corn ensilage, at $2.75 per ton, | 0 27 |
| 43.50 pounds corn fodder, at $7.50 per ton, | 0 17 |
| | $3 61 |

16.06 pounds of dry matter fed yielded 1 pound of live weight.
Cost of feed for the production of 1 pound of live weight, 13.75 cents.

The composition of the fodder articles used during the experiment is the same as of those in preceding feeding records used during the corresponding months of the year.

*Essential Fertilizing Constituents.*

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

| | Wheat Bran. | Gluten Meal. | Rowen. | Corn Ensilage. | Corn Meal. | Corn Fodder. |
|---|---|---|---|---|---|---|
| Moisture at 100° C., . | 9.27 | 9.80 | 13.53 | 72.95 | 88.33 | 20.42 |
| Nitrogen, . . . | 2.545 | 4.510 | 1.790 | 0.33 | 1.479 | 1.058 |
| Phosphoric acid, . . | 2.900 | 0.392 | 0.351 | 0.138 | 0.713 | 0.510 |
| Potassium oxide, . . | 1.637 | 0.049 | 0.462 | 0.301 | 0.430 | 0.760 |
| Valuation per ton, . | $13 60 | $16 18 | $6 92 | $1 56 | $6 27 | $4 89 |

## III. Feeding Experiments with Young Pigs.

1. General remarks on feeding experiments with young pigs, reported in the preceding report, 1889.
2. Feeding experiments with pigs, 1890. Medium Yorkshire.
3. Feeding experiments with pigs, 1890. Medium Yorkshire and grade Chester White.

### *1. Some General Remarks on raising Young Pigs for the Meat Market.*

In planning our experiments for raising young pigs for the meat market, it was proposed at the outset (1884) to confine our inquiry, for the present, in particular to the following question: —

How can we most profitably dispose of two by-products of the dairy, — skim-milk and creamery buttermilk, — as a constituent of the daily diet of young pigs raised for the meat market?

From our preceding reports in this connection, it will be seen that we consider *two conditions* on farms, namely, a *large supply* of either home-made skim-milk or of creamery buttermilk, or a *limited one*, when making up the fodder combination for the daily diet of the animals on trial.

As the first requirement of an *economical* diet for any kind of farm live stock consists in a desirable nutritive character of the feed, suitable to the kind, the condition and the purpose of the animal on trial, it became our first aim to obtain, in all cases, as far as practicable, a corresponding nutritive character of the different fodder combinations to be used.

This circumstance was secured in the following way: whenever a liberal supply of either kind of waste milk was on hand, the subsequently first stated course of compounding the daily diet of the pigs was adopted; while, in case of a limited supply of either kind of milk, the second mode has been practiced, to provide for the increasing call for a suitable feed. In case of the use of grain feed, water has taken the place of milk for diffusing the latter when fed.

I.

| Live Weight of Animal. | Corn Meal, Skim-milk. |
|---|---|
| 20 to 70 pounds, . . | 2 ounces for every quart of milk consumed. |
| 70 to 130 pounds, . . | 4 ounces for every quart of milk consumed. |
| 130 to 200 pounds, . . | 6 ounces for every quart of milk consumed. |

II.

| Live Weight of Animal. | Grain Mixture to Supplement Skim-milk and Corn Meal. | | |
|---|---|---|---|
| | Gluten Meal. (Weight Parts.) | Wheat Bran. (Weight Parts.) | Corn Meal. (Weight Parts.) |
| 20 to 70 pounds, . . . . | 2 | 1 | – |
| 70 to 130 pounds, . . . . | 1 | 1 | 1 |
| 130 to 200 pounds, . . . . | 1 | 1 | 2 |

| Live Weight of Animal. | Nutritive Character of the Feed in Both Instances. |
|---|---|
| 20 to 70 pounds, | 1 digestible nitrogenous organic constituent.<br>2.8–3 non-nitrogenous organic constituents. |
| 70 to 130 pounds, | 1 digestible nitrogenous organic constituent.<br>3.6–4 non-nitrogenous organic constituents. |
| 130 to 200 pounds, | 1 digestible nitrogenous organic constituent.<br>4.5–5 non-nitrogenous organic constituents. |

Our observations in this connection with the management of twelve feeding experiments, lead to the following suggestions regarding a proper course of raising pigs for the meat market : —

1. Begin as early as practicable, with a well-regulated system of feeding. During the moderate season, begin when the animals have reached from eighteen to twenty pounds in live weight ; in the colder seasons, when they weigh from twenty-five to thirty pounds.

2. The feed for young pigs during their earlier stages of growth ought to be somewhat bulky, to promote the extension of their digestive organs, and to make them thereafter good eaters. A liberal supply of skim-milk or buttermilk,

with a periodical increase of corn meal, beginning with two ounces of corn meal per quart of milk, has given us highly satisfactory results.

3. Change the character of the diet, at certain stages of growth, from a rich nitrogenous diet to that of a wider ratio between the digestible nitrogenous and non-nitrogenous food constituents of the feed. Begin, for instance, with two ounces of corn meal to one quart of skim-milk; when the animal has reached from sixty to seventy pounds, use four ounces per quart; and feed six ounces of meal per quart after its live weight amounts to from one hundred and twenty to one hundred and thirty pounds. The superior feeding effect, noticed in case of one and the same diet during the earlier stages of growth, will not infrequently be found to decrease seriously during later stages.

4. It is not good economy to raise pigs for the meat market to an exceptionally high weight. To go beyond from one hundred and seventy-five to one hundred and eighty pounds is only advisable when exceptionally high market prices for dressed pork can be secured. The quality of the meat is also apt to be impaired by an increased deposition of fat. The power of assimilating food, and of converting it in an economical way into an increase of live weight, decreases with the progress of age.

5. It pays well, as far as the cost of feed is concerned, to protect the animals against the extremes of the season. Feeding experiments carried on during moderate seasons are more profitable than those carried on, under otherwise corresponding circumstances, during the winter season.

Our experiments previous to 1890 have been carried on with mixed breeds of a more or less doubtful parentage. Within the past year we began to compare thoroughbreds of distinct breeds with each other or with grades of known origin. The subsequent pages contain a description of two experiments, — one with medium Yorkshires, the other with medium Yorkshires and grade Chester Whites.

Another experiment with throughbreds — Berkshire, Tamworth, small Yorkshire and Poland China — is finished; the results will be published in connection with a second one of the same character as soon as the latter is closed.

## *Summary of Experiments I. to XII.*

[Based on the same cost of feed and value of manurial refuse.]

| EXPERIMENT. | | Number of Pigs. | Average Weight of Pigs at Beginning of Experiment (Pounds). | Average Weight of Pigs at Close of Experiment (Pounds). | Articles of Fodder used. | Nutritive Ratio of Feed. | Pounds of Dry Matter consumed for the Production of One Pound of Dressed Pork. | Total Cost of Feed per Pound of Dressed Pork (Cents). | Manurial Value of Feed per Pound of Dressed Pork, after deducting Thirty Per Cent. taken by Pig (Cents). | Net Cost of Feed per Pound of Dressed Pork (Cents). |
|---|---|---|---|---|---|---|---|---|---|---|
| I. May 21 to Sept. 22, 1884, | a, | 3 | 48.8 | 239.0 | Skim-milk, corn meal, . | 1 . 2.50 to 1 : 2.97 | 2.50 to 3.11; average 2.90 | 5.15 | 1.70 | 3.45 |
| | b, | 3 | 47.6 | 253.9 | Buttermilk, corn meal, . | 1 : 2.84 to 1 . 3.38 | 2.23 to 2.57; " 2.40 | 4.30 | 1.38 | 2.92 |
| II. Nov. 5, 1884, to Mar. 21, 1885, | a, | 6 | 30.1 | 209.7 | Buttermilk, corn meal, . | 1 : 3.50 to 1 : 4.80 | 3.34 to 4.17; " 3.67 | 5.91 | 1.80 | 4.11 |
| | b, | 6 | 28.7 | 227.0 | Skim-milk, corn meal, . | 1 : 2.70 to 1 : 5.00 | 2.97 to 3.48; " 3.31 | 5.51 | 1.69 | 3.82 |
| III. April 1 to Sept. 16, 1885, . . | | 2 | 49.8 | 276.3 | Skim-milk, corn meal, .<br>Wheat bran, gluten meal, | 1 : 3.04 to 1 : 3.76 | 4.01 to 4.18; " 4.10 | 6.41 | 2.01 | 4.40 |
| IV. Dec. 8, 1885, to May 31, 1886, . | | 2 | 32.9 | 152.4 | Skim-milk, corn meal,<br>Wheat bran, gluten meal, | 1 . 2.64 to 1 : 4.48 | 3.77 to 4.08; " 3.93 | 6.33 | 2.13 | 4.20 |
| V. Sept. 15, 1886, to Jan. 19, 1887, . | | 4 | 32.6 | 175.0 | Skim-milk, corn meal, .<br>Wheat bran, gluten meal, | 1 : 2.75 to 1 : 3.57 | 3.56 to 4.31; " 3.92 | 5.40 | 2.02 | 3.38 |
| VI. Feb. 17 to May 2, 1887, . . . | | 5 | 54.4 | 152.8 | Skim-milk, corn meal, .<br>Wheat bran, gluten meal, | 1 : 2.99 to 1 . 3.23 | 2.70 to 4.20; " 3.68 | 5.69 | 1.95 | 3.74 |
| VII. June 28 to Oct. 26, 1887, . . | | 7 | 24.5 | 193.3 | Skim-milk, corn meal, .<br>Wheat bran, gluten meal, | 1 : 2.85 to 1 : 4.30 | 2.83 to 3.24; " 3.07 | 5.15 | 1.76 | 3.39 |
| VIII. Nov. 8, 1887, to March 12, 1888, . | | 6 | 25.2 | 186.4 | Skim-milk, corn meal, .<br>Wheat bran, gluten meal,<br>Corn and cob meal, . . | 1 . 2.30 to 1 : 4.17 | 3.02 to 3.46; " 3.27 | 5.32 | 1.74 | 3.58 |
| IX. April 12 to Aug. 8, 1888, . . | | 6 | 19.6 | 194.7 | Skim-milk, corn meal, .<br>Wheat bran, gluten meal,<br>Corn and cob meal, . . | 1 : 2.53 to 1 : 4.35 | 2.81 to 3.17; " 3.00 | 4.89 | 1.62 | 3.27 |
| X. April 26 to Aug. 28, 1889, . . | | 7 | 20.3 | 189.9 | Skim milk, barley meal, .<br>Wheat bran, gluten meal, | 1 : 2.90 to 1 . 4.65 | 3.40 to 3.81; " 3.60 | 6.07 | 1.75 | 4.32 |
| XI. Sept. 10, 1889, to March 3, 1890, . | | 5 | 20.8 | 189.5 | Skim-milk, corn meal, .<br>Wheat bran, gluten meal, | 1 : 2.99 to 1 4.36 | 3.80 to 3.99; " 3.89 | 6.11 | 1.98 | 4.13 |
| XII. April 22 to Sept. 1, 1890, . . | | 4* | 33.4 | 182.8 | Skim-milk, . . .<br>Corn and cob meal, . .<br>Wheat bran, gluten meal, | 1 : 2.80 to 1 : 4.25 | " 4.07 | 5.90 | 1.99 | 3.91 |
| | | 4† | 30.5 | 190.2 | | 1 : 2.80 to 1 : 4.26 | " 3.98 | 5.72 | 1.96 | 3.76 |

* Medium Yorkshires. † Grade Chester Whites.

The calculations included in the above summary were based upon the following valuations per ton: —

| | Cost. | Manurial Value. |
|---|---|---|
| Corn meal, . . . . . . . . | $24 00 | $7 97 |
| Barley meal, . . . . . . . | 30 00 | 6 21 |
| Skim-milk (10 per cent. solids), . . | 1.8 cts. gal. | 2 25 |
| Buttermilk (7 to 8 per cent. solids), . . | 1 37 " " | 1 74 |
| Corn and cob meal, . . . . . . | $20 70 | 6 06 |
| Wheat bran, . . . . . . . | 22 50 | 13 51 |
| Gluten meal, . . . . . . . | 22 50 | 17 49 |

## 2. *Eleventh Feeding Experiment with Pigs.*

Breed, medium Yorkshire; feed, skim-milk, corn meal, wheat bran and gluten meal; time, Sept. 10, 1889, to March 3, 1890.

Five pigs, sows, weighing at the beginning of the experiment from 18.5 to 21 pounds each, served for our observation. The systematic feeding began Sept. 10, 1889, and closed March 3, 1890, lasting thus 175 days. The live weight gained during that time varied in case of different animals from 160.75 to 178 pounds, with a daily average gain of .97 pound.

The daily consumption of skim-milk during the entire experiment was limited to 5 quarts per head, with the exception of the first ten days, when but 4 quarts were called for. Two ounces of corn meal were added to every quart of skim-milk consumed, to complete the daily diet for that period. The additional supply of food needed in consequence of the growth of the animal was composed of a mixture of, —

I. { Wheat bran, one weight part.
Gluten meal, two weight parts.

beginning with a daily ration of the mixture of 6 ounces per head, and increasing the quantity gradually until it

reached to from 30 to 36 ounces. This point was obtained at the close of the second month of the observation, November 11. The live weights of the different animals varied at that time from 85 to 95 pounds. The nutritive ratio, *i. e.*, the relative proportion of the digestible nitrogen-containing organic constituents and non-nitrogen-containing organic constituents, calling the former one, in the daily fodder ration, remained practically the same during the first two months (1 : 3).

The composition of the grain feed was changed at the stated advance in the growth of the animal, while the daily quantity of skim-milk per head remained the same as before, — 5 quarts. The above specified grain mixture (I.) was simply replaced by the following, —

II. { Corn meal, four weight parts.
Wheat bran, one weight part.
Gluten meal, one weight part.

beginning with a daily average ration of 32 to 36 ounces per head, and closing with one of 42 to 45 ounces, December 30, when their respective live weights varied from 125 to 130 pounds.

The subsequent change in the composition of the daily diet consisted in an increase of the proportion of the corn meal in the daily grain feed. The daily quantity of skim-milk, 5 quarts, remained the same to the end of the experiment. An amount of water was added sufficient to satisfy the thirst of the animal. The new grain mixture (III.) consisted of, —

III. { Corn meal, six weight parts.
Wheat bran, one weight part.
Gluten meal, one weight part.

The amount consumed per day rose to 48 ounces per head in some instances, toward the close of the experiment.

The entire management of the feeding was divided, as will be noticed, into three periods, as far as the nutritive character of the daily diet was concerned : —

| Periods. | Live Weight. | Nutritive Ratio. |
|---|---|---|
| I., . . | 20 to 90 pounds, . | 1 digestible nitrogenous organic constituent. 3 non-nitrogenous organic constituents. |
| II., . | 90 to 130 pounds, . | 1 digestible nitrogenous organic constituent. 3.8 non-nitrogenous organic constituents. |
| III., . | 130 to 200 pounds, | 1 digestible nitrogenous organic constituent 4.25 non-nitrogenous organic constituents. |

*Conclusions deducted from the Results obtained.*

1. The amount of dry organic matter contained in the feed consumed per pound of dressed pork secured varies in case of different animals from 3.80 to 3.99 pounds, the mean being 3.87 pounds.

2. The total cost of the feed consumed for the production of one pound of dressed pork secured varies in case of different animals from 5.43 to 5.72 cents, with a mean of 5.55 cents.

3. The total cost of the entire feed consumed during our late experiment XI. amounts to $39. The total market value of the entire amount of the essential fertilizing constituents contained in the feed consumed amounts at current market prices to $19.92. In making the customary liberal allowance of 30 per cent. for the loss sustained in nitrogen, phosphoric acid and potassium oxide, in consequence of the formation of flesh and bone in the growing animals, it will be noticed that the obtainable manurial value of the feed consumed amounts still to $13.94, which sum is fairly equal to one-third of the original cost of the entire feed used, or 1.98 cents per pound of dressed pork produced (702.75 pounds).

4. As the first cost of the feed consumed for the production of one pound of dressed pork amounted on an

average to 5.55 cents, and as the available manurial value of the feed for the same weight of dressed pork produced is equal to 1.98 cents, it will be seen that the average net cost of the feed consumed amounted to 3.57 cents per pound of dressed pork produced.

5. Comparing the financial results of the experiment here under discussion with those of an earlier experiment of ours (IV.), adopting for that purpose in both the same market price for the fodder articles consumed, and allowing at the same time a corresponding selling price for the dressed pork produced, no material difference can be pointed out. During our earlier experiment corn meal sold at $24 and wheat bran $22.50; during our previously described experiment corn meal sold at $19 and wheat bran at $16.50 per ton; skim-milk and gluten meal were charged alike in both experiments. In the earlier experiment the *net cost of the feed consumed* for the production of one pound of dressed pork was 4.20 cents, and in our recent experiment, as above stated, 3.57 cents. The difference of .63 cent in favor of the recent trial is essentially due to contemporary lower market prices of corn meal and wheat bran.

For further details, see statements upon a few subsequent pages.

*Feeding Record of Pigs.*

(1)

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Skim-milk consumed (Quarts). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Nutritive Ratio of Feed. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 10 to Sept. 30, . . | 11.63 | 93.00 | - | - | 1:3.05 | 20.75 | 38.00 | 0.82 |
| Oct. 1 to Nov. 11, . . | 26.25 | 210.00 | 20.71 | 41.42 | 1:2.99 | 38.00 | 90.50 | 1.25 |
| Nov. 12 to Dec. 30, . . | 73.52 | 245.00 | 18.38 | 18.38 | 1:3.81 | 90.50 | 133.50 | 0.88 |
| Dec. 31 to Mar. 3, . . | 120.12 | 334.00 | 20.02 | 20.02 | 1:4.06 | 133.50 | 187.75 | 0.86 |

*Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.*

| | Pounds. |
|---|---|
| 231.52 pounds corn meal, equal to dry matter, | 204.50 |
| 882.00 quarts skim-milk, equal to dry matter, | 195.60 |
| 59 11 pounds wheat bran, equal to dry matter, | 53.63 |
| 79.82 pounds gluten meal, equal to dry matter, | 72.00 |
| Total amount of dry matter, | 525.73 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 20.75 |
| Live weight at time of killing, | 187.75 |
| Live weight gained during experiment, | 167.00 |
| Dressed weight at time of killing, | 155.50 |
| Loss in weight by dressing, | 32.25 pounds, or 17.18 per cent. |
| Dressed weight gained during experiment, | 138.50 |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 231.52 pounds corn meal, at $19.00 per ton, | $2 20 |
| 220.50 gallons skim-milk, at 1.8 cents per gallon, | 3 97 |
| 59 11 pounds wheat bran, at $16.50 per ton, | 0 49 |
| 79.82 pounds gluten meal, at $23.00 per ton, | 0 92 |
| | $7 58 |

3.15 pounds of dry matter fed yielded 1 pound of live weight, and 3.80 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.47 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.49 cents.

(2)

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Skim-milk consumed (Quarts). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Nutritive Ratio of Feed. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 10 to Sept. 30, | 11.63 | 93.00 | - | - | 1 : 3.05 | 19.00 | 37.00 | 0.86 |
| Oct. 1 to Nov. 11, | 26.25 | 210.00 | 22.46 | 44.92 | 1 : 2.99 | 37.00 | 93.75 | 1.35 |
| Nov. 12 to Dec. 30, | 68.48 | 245.00 | 17.12 | 17.12 | 1 : 3.74 | 93.75 | 127.00 | 0.68 |
| Dec. 31 to Mar. 3, | 156.36 | 334.00 | 26.06 | 26.06 | 1 : 4.36 | 127.00 | 197.25 | 1.12 |

*Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.*

| | Pounds. |
|---|---|
| 262.72 pounds corn meal, equal to dry matter, | 232.06 |
| 882.00 quarts skim-milk, equal to dry matter, | 195.60 |
| 65.64 pounds wheat bran, equal to dry matter, | 59.56 |
| 88.10 pounds gluten meal, equal to dry matter, | 79.47 |
| Total amount of dry matter, | 566.69 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 19.00 |
| Live weight at time of killing, | 197.25 |
| Live weight gained during experiment, | 178.25 |
| Dressed weight at time of killing, | 163.50 |
| Loss in weight by dressing, | 33.75 pounds, or 17.11 per cent. |
| Dressed weight gained during experiment, | 147.75 |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 262.72 pounds corn meal, at $19.00 per ton, | $2 50 |
| 220.50 gallons skim-milk, at 1.8 cents per gallon, | 3 97 |
| 65.64 pounds wheat bran, at $16.50 per ton, | 0 54 |
| 88.10 pounds gluten meal, at $23.00 per ton, | 1 01 |
| | $8 02 |

3.18 pounds of dry matter fed yielded 1 pound of live weight, and 3.84 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.43 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.45 cents.

(3)

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Skim-Milk consumed (Quarts). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Nutritive Ratio of Feed. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 10 to Sept. 30, | 11.63 | 93.00 | – | – | 1 : 3.05 | 24.25 | 41.75 | 0.83 |
| Oct. 1 to Nov. 11, | 26.25 | 210.00 | 22.08 | 44.16 | 1 : 2.99 | 41.75 | 92.75 | 1.21 |
| Nov. 12 to Dec. 23, | 83.48 | 210.00 | 20.87 | 20.87 | 1 : 4.08 | 92.75 | 136.50 | 1.04 |
| Dec. 24 to Mar. 3, | 153.30 | 369.00 | 25.55 | 25.55 | 1 : 4.23 | 136.50 | 199.00 | 0.89 |

*Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.*

| | Pounds. |
|---|---|
| 274.66 pounds corn meal, equal to dry matter, | 242.61 |
| 882.00 quarts skim-milk, equal to dry matter, | 195.60 |
| 68.50 pounds wheat bran, equal to dry matter, | 62.15 |
| 90.58 pounds gluten meal, equal to dry matter, | 81.70 |
| Total amount of dry matter, | 582.06 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 24.25 |
| Live weight at time of killing, | 199.00 |
| Live weight gained during experiment, | 174.75 |
| Dressed weight at time of killing, | 167.00 |
| Loss in weight by dressing, . . . 32.00 pounds, or 16.08 per cent. | |
| Dressed weight gained during experiment, | 146.75 |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 274.66 pounds corn meal, at $19.00 per ton, | $2 61 |
| 220.50 gallons skim-milk, at 1.8 cents per gallon, | 3 67 |
| 68.50 pounds wheat bran, at $16.50 per ton, | 0 57 |
| 90.58 pounds gluten meal, at $23.00 per ton, | 1 04 |
| | $8 19 |

3.33 pounds of dry matter fed yielded 1 pound of live weight, and 3.97 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.58 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.60 cents.

(4)

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Skim-milk consumed (Quarts). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Nutritive Ratio of Feed. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 10 to Sept. 30, . | 11.63 | 93.00 | - | - | 1:3.05 | 21.25 | 38.00 | 0.80 |
| Oct. 1 to Nov. 11, . | 26.25 | 210.00 | 22.46 | 44.92 | 1:2.99 | 38.00 | 90.25 | 1.24 |
| Nov. 12 to Dec. 23, . | 79.12 | 210.00 | 19.78 | 19.78 | 1:4.03 | 90.25 | 132.00 | 0.99 |
| Dec. 24 to Mar. 3, . | 118.68 | 369.00 | 19.78 | 19.78 | 1:3.94 | 132.00 | 184.00 | 0.74 |

*Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.*

| | Pounds. |
|---|---|
| 235.68 pounds corn meal, equal to dry matter, | 208.18 |
| 882.00 quarts skim-milk, equal to dry matter, | 195.60 |
| 62.02 pounds wheat bran, equal to dry matter, | 56.09 |
| 84.48 pounds gluten meal, equal to dry matter, | 76.20 |
| Total amount of dry matter, | 536.07 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 21.25 |
| Live weight at time of killing, | 184.00 |
| Live weight gained during experiment, | 162.75 |
| Dressed weight at time of killing, | 152.00 |
| Loss in weight by dressing, . . . 32.00 pounds, or 17.39 per cent. | |
| Dressed weight gained during experiment, | 134.50 |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 235.68 pounds corn meal, at $19.00 per ton, | $2 24 |
| 220.50 gallons skim-milk, at 1.8 cents per gallon, | 3 97 |
| 62.02 pounds wheat bran, at $16.50 per ton, | 0 51 |
| 84.48 pounds gluten meal, at $23.00 per ton, | 0 97 |
| | $7 69 |

3.29 pounds of dry matter fed yielded 1 pound of live weight, and 3.99 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.72 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.74 cents.

(5)

| FEEDING PERIODS. | Total Amount of Corn Meal consumed (Pounds). | Total Amount of Skim-milk consumed (Quarts). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Nutritive Ratio of Feed. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at Close of Period (Pounds). | Gain in Weight per Day (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1889-1890.** | | | | | | | | |
| Sept. 10 to Sept. 30, | 11.63 | 93.00 | – | – | 1 : 3.05 | 18.75 | 35.75 | 0.81 |
| Oct. 1 to Nov. 11, | 26.25 | 210.00 | 20.08 | 40.16 | 1 : 2.98 | 35.75 | 83.50 | 1.14 |
| Nov. 12 to Jan. 6, | 68.25 | 280.00 | 17.06 | 17.06 | 1 : 3.61 | 83.50 | 128.00 | 0.80 |
| Jan. 7 to Mar. 3, | 124.14 | 299.00 | 20.69 | 20.69 | 1 : 4.23 | 128 00 | 179.50 | 0.92 |

*Total Amount of Feed consumed from Sept. 10, 1889, to March 3, 1890.*

| | Pounds. |
|---|---|
| 230.27 pounds corn meal, equal to dry matter, | 203.40 |
| 882.00 quarts skim-milk, equal to dry matter, | 195.60 |
| 57.83 pounds wheat bran, equal to dry matter, | 52.47 |
| 77.91 pounds gluten meal, equal to dry matter, | 70.27 |
| Total amount of dry matter, | 521.74 |

| | Pounds. |
|---|---|
| Live weight of animal at beginning of experiment, | 18.75 |
| Live weight at time of killing, | 179.50 |
| Live weight gained during experiment, | 160.75 |
| Dressed weight at time of killing, | 151.00 |
| Loss in weight by dressing, . . . 28.50 pounds, or 15.87 per cent. | |
| Dressed weight gained during experiment, | 135.25 |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 230.27 pounds corn meal, at $19.00 per ton, | $2 19 |
| 220.50 gallons skim-milk, at 1.8 cents per gallon, | 3 97 |
| 57.83 pounds wheat bran, at $16.50 per ton, | 0 48 |
| 77.91 pounds gluten meal, at $23.00 per ton, | 0 90 |
| | $7 54 |

3.25 pounds of dry matter fed yielded 1 pound of live weight, and 3.86 pounds of dry matter yielded 1 pound of dressed weight.

Total cost of feed for the production of 1 pound of dressed pork, 5.57 cents.

Net cost of feed for the production of 1 pound of dressed pork, 3.59 cents.

*Summary of Experiment XI.*

| | Corn Meal (Pounds). | Skim-milk (Gallons). | Wheat Bran (Pounds). | Gluten Meal (Pounds). | Live Weight gained during Experiment (Pounds). | Dressed Weight gained during Experiment (Pounds). | Cost per Pound of Dressed Pork (Cents). |
|---|---|---|---|---|---|---|---|
| Pig No. 1, | 231.52 | 220.5 | 59.11 | 79.82 | 167.00 | 138.50 | 5.47 |
| Pig No. 2, | 262.72 | 220.5 | 65.64 | 88 10 | 178.25 | 147.75 | 5.43 |
| Pig No. 3, | 274.66 | 220 5 | 68 50 | 90.58 | 174.75 | 146.75 | 5.58 |
| Pig No. 4, | 235.68 | 220.5 | 62.02 | 84.48 | 162.75 | 134.50 | 5.72 |
| Pig No. 5, | 230.27 | 220.5 | 57 83 | 77.91 | 160.75 | 1 5.25 | 5.57 |
| Total, | 1,234.85 | 1,102.5 | 313 10 | 420.89 | 843.50 | 702.75 | – |

*Total Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 1,102 50 gallons skim-milk, at 1.8 cents per gallon, . . . . | $19 85 |
| 1,234.85 pounds corn meal, at $19.00 per ton, . . . . | 11 73 |
| 313.10 pounds wheat bran, at $16.50 per ton, . . . . | 2 58 |
| 420.89 pounds gluten meal, at $23.00 per ton, . . . . | 4 84 |
| | $39 00 |

Average cost of feed for production of 1 pound of dressed pork, 5.55 cents.

Average net cost of feed for production of 1 pound of dressed pork, after deducting the manurial value less 30 per cent., 3.57 cents.

*Valuation of Essential Fertilizing Constituents in the Various Articles of Fodder used.*

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

| | Corn Meal. | Skim-milk | Wheat Bran. | Gluten Meal |
|---|---|---|---|---|
| Moisture at 100° C., . . . . | 11.67 | 89.78 | 9.27 | 9.80 |
| Nitrogen, . . . . . . | 1.479 | 0.52 | 2.545 | 4.510 |
| Phosphoric acid, . . . . | 0.713 | 0.19 | 2.900 | 0.392 |
| Potassium oxide, . . . . | 0.430 | 0.20 | 1.637 | 0.049 |
| Valuation per 2,000 pounds, . | $6 27 | $2 18 | $14 59 | $15 85 |

*Manurial Value of Feed consumed during Experiment.*

| Corn Meal. | Skim-milk. | Wheat Bran. | Gluten Meal. | Total. |
|---|---|---|---|---|
| $3 87 | $10 43 | $2 28 | $3 34 | $19 92 |

The manurial value of feed for the production of 1 pound of dressed pork is 2 83 cents; after the deduction of 30 per cent., 1.98 cents.

*Composition of Fodder Articles fed during the Previously Described Experiment*

*Skim-milk (Average).*

[One quart = 2.17 pounds.]

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 89.78 | 1,795.60 | – | – | 1 : 2.13 |
| Dry matter, | 10.22 | 204.40 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.85 | 137.00 | – | – | |
| " cellulose, | – | – | – | – | |
| " fat, | 3.82 | 76.40 | 76.40 | 100 | |
| " protein (nitrogenous matter), | 31.60 | 632.00 | 632.00 | 100 | |
| Non-nitrogenous extract matter, | 57.73 | 1,155.60 | 1,155.60 | 100 | |
| | 100.00 | 2,000.00 | 1,864.00 | – | |

*Gluten Meal.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 9.80 | 196.00 | – | – | 1 : 2.60 |
| Dry matter, | 90.20 | 1,804.00 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 1.25 | 25.00 | – | – | |
| " cellulose, | 1.75 | 35.00 | 11.90 | 34 | |
| " fat, | 7.00 | 140.00 | 106.40 | 76 | |
| " protein (nitrogenous matter), | 31.25 | 625.00 | 531.25 | 85 | |
| Non-nitrogenous extract matter, | 58.75 | 1,175.00 | 1,104.50 | 94 | |
| | 100.00 | 2,000.00 | 1,754.05 | – | |

For analyses of corn meal and wheat bran used in this experiment, see winter cow feeding experiment.

### 3. *Twelfth Feeding Experiment with Pigs.*

Breed, medium Yorkshire, grade Chester White; feed, skim-milk, corn and cob meal, wheat bran, gluten meal; time, April 22 to Sept. 1, 1890.

Eight pigs, four medium Yorkshires and four grade Chester Whites, were secured for the trial. Each lot consisted of two sows and two barrows. The individual live weight of the medium Yorkshires varied from 30 to 37 pounds, and that of the grade Chester Whites from 28.75 to 33 pounds, at the beginning of the observation. The feeding began April 22 and closed September 1, thus covering a period of 133 days.

The general course pursued in the management of the experiment is materially the same as adopted in the preceding VII., VIII., IX., X., XI. The main alteration consists in the substitution of corn and cob meal in place of the corn meal. The amount of skim-milk consumed daily per head remained practically the same, after the first week, — four quarts. To every quart of milk required were added two ounces of corn and cob meal. The additional feed subsequently needed consisted of a mixture of two weight parts of gluten meal and one of wheat bran. At the close of the second month of our trial, when the live weights of the various animals amounted to from 120 to 130 pounds each, the diet was changed; a mixture of four weight parts of corn and cob meal and one weight part each of gluten meal and wheat bran was fed with the original quantity of skim-milk, — four quarts daily per head. The subsequent tabular statement shows the changes in the nutritive character of the feed at different stages of growth. The entire experiment might be divided practically into three feeding periods: —

| | Live Weight. | Nutritive Ratio. |
|---|---|---|
| Period I., . . . . . . . . | 20 to 90 pounds. | 1 : 2.83 |
| Period II., . . . . . . . . | 90 to 130 pounds. | 1 : 3.60 |
| Period III., . . . . . . . . | 130 to 200 pounds. | 1 : 4.25 |

The live weight gained during the experiment amounted in the case of the four medium Yorkshires to 596 pounds, and in the case of the four grade Chester Whites to 640 pounds, showing an increase of 44 pounds in favor of the latter.

*Medium Yorkshires.*

| | Pounds. | Pounds. |
|---|---|---|
| 1. Sow, live weight at beginning, | 37.00 | Live weight at close, 174.5 |
| 2. Barrow, live weight at beginning, | 32.25 | Live weight at close, 197.0 |
| 3. Sow, live weight at beginning, | 30.00 | Live weight at close, 163.0 |
| 4. Barrow, live weight at beginning, | 34.25 | Live weight at close, 195.0 |
| | 133.50 | 729.5 |

*Grade Chester Whites.*

| | Pounds. | Pounds. |
|---|---|---|
| 1. Sow, live weight at beginning, | 31.25 | Live weight at close, 207.0 |
| 2. Sow, live weight at beginning, | 33.00 | Live weight at close, 177.5 |
| 3. Barrow, live weight at beginning, | 29.00 | Live weight at close, 199.0 |
| 4. Barrow, live weight at beginning, | 28.75 | Live weight at close, 178.5 |
| | 122.00 | 762.0 |

The live weight gained during the experiment varied, as will be noticed from the preceding detailed record in case of different animals of medium Yorkshires from 133 to 164.75 pounds, and in case of grade Chester Whites from 144.5 to 175.75 pounds. Considering in both cases the entire lot, the average gain in live weight per head is 149 pounds in case of the medium Yorkshires, and 160 pounds in that of grade Chester Whites. This difference in the live weights of both lots disappears in the weights of the dressed pork.

*Medium Yorkshires.*

| | Pounds. |
|---|---|
| 1. Dressed weight, | 134 |
| 2. Dressed weight, | 158 |
| 3. Dressed weight, | 130 |
| 4. Dressed weight, | 157 |
| Total, | 579 |

*Grade Chester Whites.*

| | Pounds. |
|---|---|
| 1. Dressed weight, | 160 |
| 2. Dressed weight, | 128 |
| 3. Dressed weight, | 151 |
| 4. Dressed weight, | 138 |
| Total, | 577 |

The shrinkage of the medium Yorkshires was equal to 21 per cent., and that of the grade Chester Whites 24 per cent., of their live weights. The large percentage of shrinkage is mainly due to the fact that by some oversight the animals had been fed once on the day of killing. The medium Yorkshires lead the grade Chester Whites by two pounds in dressed weight, making the result an exceptionally close one.

Four and seven-hundredths pounds of dry matter in the feed produced one pound of dressed pork in the case of the medium Yorkshires, while 3.98 pounds of dry matter in the feed produced one pound of dressed pork in case of grade Chester Whites.

The market cost of feed consumed for the production of one pound of dressed pork was 5.60 cents in the case of medium Yorkshires, and 5.45 cents in that of the grade Chester Whites. The market cost of the feed consumed is $26.51 in the case of the medium Yorkshires, and in that of the grade Chester Whites it is $26.41.

The manurial value of the nitrogen, phosphoric acid and potassium oxide contained in the feed consumed is in the first-named instance equal to $13.46, and in the latter $13.59. Allowing 30 per cent. of the stated essential fertilizing constituents as retained in the organization of the growing animal and thus lost, there remain 70 per cent. of them obtainable in the manure. The obtainable portion of the manurial constituents of the feed is worth $9.42 in the case of the medium Yorkshires, and $9.51 in that of the grade Chester Whites, making the net cost of feed in the first-named lot $17.09, and in the second lot $16.90.

The net cost of the feed consumed for the production of one pound of dressed pork is 3.61 cents in the case of the medium Yorkshires, and 3.49 cents in that of the grade Chester Whites, — a difference of .12 cent per pound in favor of the latter.

*Medium Yorkshires (Four Pigs).*

| FEEDING PERIODS. | Total Amount of Corn and Cob Meal consumed (Pounds). | Total Amount of Skim-milk consumed (Quarts). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Nutritive Ratio of Feed. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1890.** | | | | | | | | |
| April 22 to June 2, | 88.69 | 713.50 | 35.94 | 71.88 | 1 : 2.83 | 133.50 | 286.00 | 3.54 |
| June 3 to July 21, | 351.56 | 882.00 | 131.06 | 131.06 | 1 : 3.68 | 286.00 | 515.75 | 4.69 |
| July 22 to Sept. 8, | 532.51 | 876.00 | 114.40 | 114.40 | 1 : 4.25 | 515.75 | 729.50 | 4.36 |

*Total Amount of Feed consumed from April 22 to Sept. 8, 1890.*

| | Pounds. |
|---|---|
| 972.76 pounds corn and cob meal, equal to dry matter, | 836.28 |
| 2,471.50 quarts skim-milk, equal to dry matter, | 548.11 |
| 281.40 pounds wheat bran, equal to dry matter, | 248.98 |
| 317.34 pounds gluten meal, equal to dry matter, | 290.43 |
| Total amount of dry matter, | 1,923.80 |

| | | Pounds. |
|---|---|---|
| Aggregate live weight of animals at beginning of experiment, | | 133.50 |
| Aggregate live weight at time of killing, | | 729.50 |
| Live weight gained during experiment, | | 596.00 |
| Dressed weight at time of killing, | | 579.00 |
| Loss in weight by dressing, | 20.63 per cent., or | 150.50 |
| Dressed weight gained during experiment, | | 473.04 |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 972.76 pounds corn and cob meal, at \$18.00 per ton, | \$8 75 |
| 617.88 gallons skim-milk, at 1.8 cents per gallon, | 11 12 |
| 281.40 pounds wheat bran, at \$19.00 per ton, | 2 67 |
| 317.34 pounds gluten meal, at \$25.00 per ton, | 3 97 |
| | \$26 51 |

3.23 pounds of dry matter fed yielded 1 pound of live weight, and 4.07 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for the production of 1 pound of dressed pork at stated market prices, 5.60 cents.

Net cost per pound of dressed pork produced, 3.61 cents.

*Grade Chester Whites (Four Pigs).*

| FEEDING PERIODS. | Total Amount of Corn and Cob Meal consumed (Pounds). | Total Amount of Skim-milk consumed (Quarts). | Total Amount of Wheat Bran consumed (Pounds). | Total Amount of Gluten Meal consumed (Pounds). | Nutritive Ratio of Feed. | Weight of Animal at Beginning of Period (Pounds). | Weight of Animal at End of Period (Pounds). | Gain in Weight per Day during Period (Pounds). |
|---|---|---|---|---|---|---|---|---|
| **1890.** | | | | | | | | |
| April 22 to June 2, | 90.25 | 728.00 | 46.21 | 92.42 | 1 : 2.81 | 122.00 | 312.00 | 4.52 |
| June 3 to July 21, | 353.94 | 882.00 | 133.44 | 133.44 | 1 : 3.68 | 312.00 | 541.00 | 4.67 |
| July 22 to Sept. 1, | 504.47 | 750.00 | 123.99 | 123.99 | 1 : 4.26 | 541.00 | 762.00 | 5.26 |

*Total Amount of Feed consumed from April 22 to Sept. 1, 1890.*

| | Pounds. |
|---|---|
| 948.66 pounds corn and cob meal, equal to dry matter, | 815.56 |
| 2,360.00 quarts skim-milk, equal to dry matter, | 523.39 |
| 303.63 pounds wheat bran, equal to dry matter, | 268.65 |
| 349.85 pounds gluten meal, equal to dry matter, | 320.18 |
| Total amount of dry matter, | 1,927.78 |

| | Pounds. |
|---|---|
| Aggregate live weight of animals at beginning of experiment, | 122.00 |
| Aggregate live weight at time of killing, | 762.00 |
| Live weight gained during experiment, | 640.00 |
| Dressed weight at time of killing, | 577.00 |
| Loss in weight by dressing, 24.28 per cent, or | 185.00 |
| Dressed weight gained during experiment, | 484.62 |

*Cost of Feed consumed during Experiment.*

| | |
|---|---|
| 948.66 pounds corn and cob meal, at $18.00 per ton, | $8 54 |
| 590.00 gallons skim-milk, at 1.8 cents per gallon, | 10 62 |
| 303.63 pounds wheat bran, at $19.00 per ton, | 2 88 |
| 349.85 pounds gluten meal, at $25.00 per ton, | 4 37 |
| | $26 41 |

3.01 pounds of dry matter fed yielded 1 pound of live weight, and 3.98 pounds of dry matter yielded 1 pound of dressed weight.

Cost of feed for the production of 1 pound of dressed pork at stated market prices, 5.45 cents.

Net cost per pound of dressed pork produced, 3.49 cents.

*Valuation of Essential Fertilizing Constituents in the Various Fodder Articles used.*

Nitrogen, 17 cents per pound; phosphoric acid, 6 cents; potassium oxide, 4½ cents.

| | Corn and Cob Meal. | Skim-milk | Wheat Bran. | Gluten Meal. |
|---|---|---|---|---|
| Moisture at 100° C., | 14.03 | 89.78 | 11.52 | 8.48 |
| Nitrogen, | 1.279 | 0.520 | 2.600 | 5.358 |
| Phosphoric acid, | 0.576 | 0.190 | 2.870 | 0.425 |
| Potassium oxide, | 0.440 | 0.200 | 1.620 | 0.045 |
| Valuation per 2,000 pounds, | $5 43 | $2 18 | $13 74 | $19 13 |

*Manurial Value of the Feed.*

| | Grade Chester Whites. | Medium Yorkshires. |
|---|---|---|
| Corn and cob meal, | $2 58 | $2 65 |
| Skim-milk, | 5 58 | 5 85 |
| Wheat bran, | 2 09 | 1 93 |
| Gluten meal, | 3 34 | 3 03 |
| | $13 59 | $13 46 |

*Composition of Fodder Articles fed during the Previously Described Experiment.*

*Corn and Cob Meal.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 14.03 |
| Dry matter, | 85.97 |
| | 100.00 |

*Analysis of Dry Matter*

| | |
|---|---|
| Crude ash, | 1.74 |
| " cellulose, | 3.96 |
| " fat, | 3.59 |
| " protein (nitrogenous matter), | 9.30 |
| Non-nitrogenous extract matter, | 81.41 |
| | 100.00 |

*Corn Meal (Average).*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 12.39 | 247.80 | – | – | 1 : 9.70 |
| Dry matter, | 87.61 | 1,752.20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 1.80 | 36.00 | – | – | |
| " cellulose, | 1.80 | 36.00 | 12.24 | 34 | |
| " fat, | 5.01 | 100.20 | 76.15 | 76 | |
| " protein (nitrogenous matter), | 10.46 | 209.20 | 177.82 | 85 | |
| Non-nitrogenous extract matter, | 80.93 | 1,618.60 | 1,521.48 | 94 | |
| | 100.00 | 2,000.00 | 1,787.69 | – | |

Skim-milk, same as in pig feeding experiment XI.
Wheat bran, same as in summer cow feeding experiment.

## IV. Fodder Analyses. (1890.)

The majority of the analyses stated under the above heading are made of fodder articles which have been used either during the past year in connection with some of our feeding experiments, or have been raised upon the grounds of the station. Some articles sent on by outside parties are added, on account of the special interest they may present to others.

In presenting these analyses, it seems but proper to call the attention of farmers once more forcibly to a careful consideration of the following facts.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind after it has served its purpose as a constituent of the food consumed.

As the financial success in a mixed farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserve the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live stock.

The higher or lower commercial value of the manurial refuse left behind after the feed has accomplished its purpose in a satisfactory degree, decides its actual or net cost in farm industry. A disregard of this circumstance renders, in many instances, a remunerative dairying not less doubtful than a profitable feeding of live stock for the meat market.

*Corn Meal.*

[Amherst Mill.]

84.98 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 13.00 | 260.00 | – | – | 1 : 9.94 |
| Dry matter, | 87.00 | 1,740.00 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 1.10 | 22.00 | – | – | |
| " cellulose, | 2.09 | 41.80 | 14.21 | 34 | |
| " fat, | 4.95 | 99.00 | 75.24 | 76 | |
| " protein (nitrogenous matter), | 10.27 | 205.40 | 174.59 | 85 | |
| Non-nitrogenous extract matter, | 81.59 | 1,631.80 | 1,533.89 | 94 | |
| | 100.00 | 2,000.00 | 1,797.93 | – | |

*Corn and Cob Meal.*

[Amherst Mill.]

| | Per Cent. I. | Per Cent. II. |
|---|---|---|
| Moisture at 100° C., | 8.10 | 14.03 |
| Dry matter, | 91.90 | 85.97 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 1.47 | 1.74 |
| " cellulose, | 5.63 | 3.96 |
| " fat, | 3.73 | 3.59 |
| " protein (nitrogenous matter), | 9.79 | 9.30 |
| Non-nitrogenous extract matter, | 79.38 | 81.41 |
| | 100.00 | 100.00 |
| Passed screen 144 meshes to square inch, | 76.34 | 72.48 |

*Corn Meal.*

[Amherst Mill ]

87.90 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 13.64 | 272.80 | – | – | 1 : 9.95 |
| Dry matter, | 86 36 | 1,727.20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 2.52 | 50.40 | – | – | |
| " cellulose, | 1.78 | 35.60 | 12 10 | 34 | |
| " fat, | 4.83 | 96.60 | 73.42 | 76 | |
| " protein (nitrogenous matter), | 10.13 | 202.60 | 172.21 | 85 | |
| Non-nitrogenous extract matter, | 80.74 | 1,614.80 | 1,517.91 | 94 | |
| | 100.00 | 2,000.00 | 1,775.64 | – | |

*Corn Meal.*

[Amherst Mill.]

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 12.39 | 247.80 | – | – | 1 : 9 30 |
| Dry matter, | 87.64 | 1,752 20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 1.80 | 36.00 | – | – | |
| " cellulose, | 1 80 | 36.00 | 12.24 | 34 | |
| " fat, | 5.01 | 100.20 | 76.15 | 76 | |
| " protein (nitrogenous matter), | 10.46 | 209.20 | 177.82 | 85 | |
| Non-nitrogenous extract matter, | 80.93 | 1,618 60 | 1,521.48 | 94 | |
| | 100.00 | 2,000.00 | 1,787.69 | – | |

*Corn Meal.*

[Sent on from Bolton, Mass ]

| | Per Cent. | | |
|---|---|---|---|
| | Cob Meal. | Corn Meal. | Corn Meal. |
| Moisture at 100° C., | 16.09 | 16.00 | 16.13 |
| Dry matter, | 83.91 | 84.00 | 83.87 |
| | 100.00 | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | | |
| Crude ash, | 2.50 | 1.82 | 1.99 |
| " cellulose, | 5.71 | 1.24 | 1.55 |
| " fat, | 4.48 | 4.21 | 5.00 |
| " protein (nitrogenous matter), | 9.69 | 11.01 | 10.43 |
| Non-nitrogenous extract matter, | 77.62 | 81.72 | 81.03 |
| | 100.00 | 100.00 | 100.00 |
| Passed screen 144 meshes to square inch, | 60.50 | 89.91 | 82.64 |

*Corn Meal.*

[Two samples, sent on by Geo. C. Fitch, East Amherst, Mass.]

| | Per Cent. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C , | 13.92 | 14.53 |
| Dry matter, | 86.08 | 85.47 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 1.59 | 1.66 |
| " cellulose, | 1.93 | 1.44 |
| " fat, | 4.95 | 4.84 |
| " protein (nitrogenous matter), | 9.73 | 10 16 |
| Non-nitrogenous extract matter, | 81.80 | 81.90 |
| | 100.00 | 100.00 |
| Passed screen 144 meshes to square inch, | 90.48 | 73.50 |

*Wheat Bran.*

[Amherst Mill.]

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 9.69 | 193.80 | – | – | 1 : 3.68 |
| Dry matter, | 90.31 | 1,806.20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.40 | 148.00 | – | – | |
| " cellulose, | 9.86 | 197.20 | 39.44 | 20 | |
| " fat, | 5.81 | 116.20 | 92.96 | 80 | |
| " protein (nitrogenous matter), | 18.60 | 372.00 | 327.36 | 88 | |
| Non-nitrogenous extract matter, | 58.33 | 1,166.60 | 933.28 | 80 | |
| | 100.00 | 2,000.00 | 1,393.04 | – | |

*Wheat Bran.*

[Amherst Mill.]

47.64 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 10.14 | 202.80 | – | – | 1 : 3.73 |
| Dry matter, | 89.86 | 1,797.20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.11 | 142.20 | – | – | |
| " cellulose, | 10.57 | 211.40 | 42.28 | 20 | |
| " fat, | 5.38 | 107.60 | 86.08 | 80 | |
| " protein (nitrogenous matter), | 18.23 | 364.60 | 320.85 | 88 | |
| Non-nitrogenous extract matter, | 58.71 | 1,174.20 | 939.36 | 80 | |
| | 100.00 | 2,000.06 | 1,388.57 | – | |

*Wheat Bran.*

[Amherst Mill.]

48.85 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., . . | 11.52 | 230.40 | – | – | 1 : 3.70 |
| Dry matter, . . . . | 88.48 | 1,769.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, . . . . | 7.13 | 142.60 | – | – | |
| " cellulose, . . . | 10.63 | 212.60 | 42.52 | 20 | |
| " fat, . . . . . | 5.62 | 112.40 | 89.92 | 80 | |
| " protein (nitrogenous matter), . . | 18.36 | 367.20 | 323.14 | 88 | |
| Non-nitrogenous extract matter, . . . . | 58.26 | 1,165.20 | 932.16 | 80 | |
| | 100.00 | 2,000.00 | 1,387.74 | – | |

*Wheat Bran.*

[Amherst Mill.]

20.04 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., . . | 12.69 | 253.80 | – | – | 1 : 3.38 |
| Dry matter, . . . . | 87.31 | 1,746.20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, . . . . | 7.06 | 141.20 | – | – | |
| " cellulose, . . . | 14.01 | 280.20 | 56.04 | 20 | |
| " fat, . . . . . | 5.47 | 109.40 | 87.52 | 80 | |
| " protein (nitrogenous matter), . . | 19.19 | 383.80 | 337.74 | 88 | |
| Non-nitrogenous extract matter, . . . . | 54.27 | 1,085.40 | 868.32 | 80 | |
| | 100.00 | 2,000.00 | 1,349.62 | – | |

### *Wheat Shorts.*

[Two samples, sent on by C. A. Newhall, Lynn, Mass.]

| | Per Cent. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 8.87 | 10.33 |
| Dry matter, | 91.13 | 89.67 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 7.14 | 7.96 |
| " cellulose, | 8.58 | 11.21 |
| " fat, | 5.86 | 5.52 |
| " protein (nitrogenous matter), | 16.71 | 17.28 |
| Non-nitrogenous extract matter, | 61.71 | 58.03 |
| | 100.00 | 100.00 |
| Passed screen 144 meshes to square inch, | 52.60 | 55.00 |

### *Wheat Shorts.*

[Sent on by W. F. Williams, South Amherst, Mass.]

| | Per Cent | |
|---|---|---|
| | Winter Bran. | Summer Bran. |
| Moisture at 100° C., | 7.42 | 7.87 |
| Dry matter, | 92.58 | 92.13 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 7.19 | 6.82 |
| " cellulose, | 8.01 | 9.87 |
| " fat, | 5.75 | 5.86 |
| " protein (nitrogenous matter), | 18.09 | 17.77 |
| Non-nitrogenous extract matter, | 60.96 | 59.68 |
| | 100.00 | 100.00 |
| Passed screen 144 meshes to square inch, | 60.40 | 61.20 |

*Old-process Linseed Meal.*

76.40 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 8.72 | 174.40 | – | – | 1 : 1.93 |
| Dry matter, | 91.28 | 1,825.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 5.96 | 119.20 | – | – | |
| " cellulose, | 8.23 | 164.60 | 42.79 | 26 | |
| " fat, | 9.87 | 197.40 | 179.63 | 91 | |
| " protein (nitrogenous matter), | 36.19 | 723.80 | 629.70 | 87 | |
| Non-nitrogenous extract matter, | 39.75 | 795.00 | 723.45 | 91 | |
| | 100.00 | 2,000.00 | 1,575.57 | – | |

*Fertilizing Constituents of Old-process Linseed Meal.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 8.72 |
| Ash, | 5.44 |
| Calcium oxide, | 0.68 |
| Magnesium oxide, | 0.69 |
| Sodium oxide, | 0.86 |
| Ferric oxide, | 0.05 |
| Potassium oxide (4¼ cents per pound), | 1.37 |
| Phosphoric acid (6 cents per pound), | 2.17 |
| Nitrogen (17 cents per pound), | 5.29 |
| Insoluble matter, | 0.31 |
| Valuation per ton, | $21 75 |

*Old-process Linseed Meal.*

87.40 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 9.30 | 186.00 | – | – | 1 : 1.78 |
| Dry matter, | 90.70 | 1,814.00 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.70 | 154.00 | – | – | |
| " cellulose, | 8.96 | 179.20 | 46.59 | 26 | |
| " fat, | 6.50 | 130.00 | 118.30 | 91 | |
| " protein (nitrogenous matter), | 35.27 | 705.40 | 613.09 | 87 | |
| Non-nitrogenous extract matter, | 41.57 | 831.40 | 756.57 | 91 | |
| | 100.00 | 2,000.00 | 1,534.55 | – | |

*Old-process Linseed Meal.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 11.50 | 230.00 | – | – | 1 : 1.50 |
| Dry matter, | 88.50 | 1,770.00 | – | – | |
| | 100.00 | 2,000 00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.08 | 121.60 | – | – | |
| " cellulose, | 8.64 | 172.80 | 44.93 | 26 | |
| " fat, | 6.43 | 128.60 | 117.03 | 91 | |
| " protein (nitrogenous matter), | 39.97 | 799.40 | 695.48 | 87 | |
| Non-nitrogenous extract matter, | 38.88 | 777.60 | 707.62 | 91 | |
| | 100.00 | 2,000.00 | 1,565.06 | – | |

*New-process Linseed Meal.*

58.84 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 5.06 | 101.20 | – | – | 1 : 1.26 |
| Dry matter, | 94.94 | 1,898.80 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.34 | 126.80 | – | – | |
| " cellulose, | 8.93 | 178.60 | 46.43 | 26 | |
| " fat, | 2.17 | 43.40 | 39.49 | 91 | |
| " protein (nitrogenous matter), | 41.02 | 820.40 | 713.74 | 87 | |
| Non-nitrogenous extract matter, | 41.54 | 830.80 | 756.02 | 91 | |
| | 100.00 | 2,000.00 | 1,555.68 | – | |

*New-process Linseed Meal.*

47.35 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 11.83 | 236.60 | – | – | 1 : 1.376 |
| Dry matter,. | 88.17 | 1,763.40 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.43 | 128.60 | – | – | |
| " cellulose, | 9.01 | 180.20 | 48.65 | 26 | |
| " fat, | 3.15 | 63.00 | 57.33 | 91 | |
| " protein (nitrogenous matter), | 39.91 | 798.20 | 694.43 | 87 | |
| Non-nitrogenous extract matter, | 41.50 | 830.00 | 755.30 | 91 | |
| | 100.00 | 2,000.00 | 1,555.71 | – | |

*New-process Linseed Meal.*

55.60 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 8.29 | 165.80 | – | – | 1 : 1.74 |
| Dry matter, | 91.71 | 1,834.20 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 5.91 | 118.20 | – | – | |
| " cellulose, | 9.43 | 188.60 | 49.04 | 26 | |
| " fat, | 4.08 | 81.60 | 74.26 | 91 | |
| " protein (nitrogenous matter), | 35.03 | 700.60 | 609.51 | 87 | |
| Non-nitrogenous extract matter, | 45.55 | 911.00 | 829.01 | 91 | |
| | 100.00 | 2,000.00 | 1,561.82 | – | |

*Fertilizing Constituents of New-process Linseed Meal.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 8.29 |
| Ash, | 5.42 |
| Calcium oxide, | 0.96 |
| Magnesium oxide, | 0.63 |
| Ferric oxide, | 0.06 |
| Potassium oxide ($4\frac{1}{4}$ cents per pound), | 1.57 |
| Phosphoric acid (6 cents per pound), | 1.80 |
| Nitrogen (17 cents per pound), | 5.14 |
| Insoluble matter, | 0.17 |
| Valuation per ton, | $20 97 |

*Cotton-seed Meal.*

[Sent on by E. H. McIntosh, Needham, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 10.50 |
| Dry matter, | 89.50 |
| | 100.00 |
| *Analysis of Dry Matter.* | |
| Crude ash, | 8.47 |
| " cellulose, | 10.40 |
| " fat, | 9.57 |
| " protein (nitrogenous matter), | 46.92 |
| Non-nitrogenous extract matter, | 24.64 |
| | 100.00 |
| Passed screen 144 meshes to square inch, | 66.24 |

*Fertilizing Constituents of Cotton-seed Meal.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 10.500 |
| Calcium oxide, | 0.295 |
| Magnesium oxide, | 0.721 |
| Sodium oxide, | 0.249 |
| Potassium oxide, | 1.830 |
| Nitrogen, | 6.720 |
| Phosphoric acid, | 2.350 |
| Insoluble matter, | 0.390 |

*Sea Island Cotton-seed Meal (Ground with Hulls on).*

[Sent on by Butler, Breed & Co., Boston, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.62 |
| Dry matter, | 88.38 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 12.07 |
| " cellulose, | 20.04 |
| " fat, | 8.90 |
| " protein (nitrogenous matter), | 26.07 |
| Non-nitrogenous extract matter, | 32.92 |
| | 100.00 |
| Passed screen 144 meshes to square inch, | 52.72 |

*Fertilizing Constituents of the Above.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.62 |
| Calcium oxide, | 0.57 |
| Magnesium oxide, | 0.60 |
| Potassium oxide (4½ cents per pound), | 1.31 |
| Phosphoric acid (6 cents per pound), | 2.09 |
| Nitrogen (15 cents per pound), | 3.59 |
| Insoluble matter, | 0.57 |
| Valuation per ton, | $14 46 |

*Gluten Meal (Chicago).*

[Springfield, Mass.]

56.40 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 10.45 | 209.00 | – | – | 1 : 2.11 |
| Dry matter, | 89.55 | 1,791.00 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 0.85 | 17.00 | – | – | |
| " cellulose, | 0.67 | 13.40 | 5.55 | 34 | |
| " fat, | 12.05 | 241.00 | 183.16 | 76 | |
| " protein (nitrogenous matter), | 38.17 | 763.40 | 648.89 | 85 | |
| Non-nitrogenous extract matter, | 48.26 | 965.20 | 907.29 | 94 | |
| | 100.00 | 2,000.00 | 1,744.89 | – | |

*Gluten Meal.*

[Springfield, Mass.]

54.10 per cent. passed screen 144 meshes to square inch.

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 6.50 | 130.00 | – | – | 1 : 2.37 |
| Dry matter, | 93.50 | 1,870.00 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 0.68 | 13.60 | – | – | |
| " cellulose, | 0.68 | 13.60 | 4.62 | 34 | |
| " fat, | 10.03 | 204.60 | 155.49 | 76 | |
| " protein (nitrogenous matter), | 35.02 | 700.40 | 588.34 | 85 | |
| Non-nitrogenous extract matter, | 53.39 | 1,067.80 | 1,003.73 | 94 | |
| | 100.00 | 2,000.00 | 1,752.18 | – | |

### *Gluten Meal.*

[I., sent on by S. N. Fletcher, South Acton, Mass.; II., sent on by J. L. Smith, Barre, Mass.]

| | Per Cent. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 7.30 | 10.70 |
| Dry matter, | 92.70 | 89.30 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 1.32 | 2.79 |
| " cellulose, | 1.14 | 6.40 |
| " fat, | 17.60 | 11.87 |
| " protein (nitrogenous matter), | 39.77 | 26.95 |
| Non-nitrogenous extract matter, | 40.17 | 51.99 |
| | 100.00 | 100.00 |
| Passed screen 144 meshes to square inch, | 84.80 | 65.64 |

### *Fertilizing Constituents of Gluten Meal.*

| | Per Cent. | |
|---|---|---|
| | I | II. |
| Moisture at 100° C., | 7.300 | 10.70 |
| Calcium oxide, | 0.051 | 0.083 |
| Magnesium oxide, | 0.035 | 0.253 |
| Ferric oxide, | 0.070 | – |
| Sodium oxide, | 0.018 | 0.165 |
| Potassium oxide ($4\frac{1}{4}$ cents per pound), | 0.045 | 0.099 |
| Phosphoric acid (6 cents per pound), | 0.429 | 0.718 |
| Nitrogen (17 cents per pound), | 5.900 | 3.850 |
| Valuation per ton, | $20 61 | $14 04 |

### *Buckwheat Middlings.*

[Sent on by J. A. Cunningham, Bolton, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.51 |
| Dry matter, | 88.49 |
| | 100.00 |

*Analysis of Dry Matter.*

| | Per Cent. |
|---|---|
| Crude ash, | 5.44 |
| " cellulose, | 5.18 |
| " fat, | 7.53 |
| " protein (nitrogenous matter), | 25.49 |
| Non-nitrogenous extract matter, | 56.36 |
| | 100.00 |

71.40 per cent. passed screen 144 meshes to square inch.

*Wheat Middlings.*

[Sent on by F. H. Williams, Sunderland, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 12.43 |
| Dry matter, | 87.57 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 4.21 |
| " cellulose, | 5.78 |
| " fat, | 3.38 |
| " protein (nitrogenous matter), | 15.13 |
| Non-nitrogenous extract matter, | 71.50 |
| | 100.00 |

94.16 per cent. passed screen 144 meshes to square inch.

*Corn Fodder (Pride of the North).*

[East Fields, collected Sept. 4, 1889.]

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 74.68 | 1,593.60 | – | – | 1 : 9.24 |
| Dry matter, | 25.32 | 506.40 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.40 | 148.00 | – | – | |
| " cellulose, | 20.11 | 402.20 | 289.58 | 72 | |
| " fat, | 1.65 | 33.00 | 24.75 | 75 | |
| " protein (nitrogenous matter), | 8.31 | 166.20 | 128.62 | 73 | |
| Non-nitrogenous extract matter, | 62.53 | 1,250.60 | 837.90 | 67 | |
| | 100.00 | 2,000.00 | 1,280.85 | – | |

*Fertilizing Constituents of Corn Fodder.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 74.680 |
| Calcium oxide, | 0.528 |
| Magnesium oxide, | 0.256 |
| Ferric oxide, | 0.078 |
| Sodium oxide, | 0.179 |
| Potassium oxide, | 0.921 |
| Phosphoric acid, | 0.495 |
| Nitrogen, | 0.337 |
| Insoluble matter, | 1.102 |
| Valuation per ton, | $2 52 |

*Corn Stover (Clark Corn).*

[Station, Field A, 1889.]

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 5.77 | 115.40 | – | – | 1 : 13.92 |
| Dry matter, | 94.23 | 1,884.60 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 7.64 | 152.80 | – | – | |
| " cellulose, | 33.70 | 674.00 | 485.28 | 72 | |
| " fat, | 1.77 | 35.40 | 26.55 | 75 | |
| " protein (nitrogenous matter), | 6.04 | 120.80 | 88.18 | 73 | |
| Non-nitrogenous extract matter, | 50.85 | 1,017.00 | 681.39 | 67 | |
| | 100.00 | 2,000.00 | 1,281.40 | – | |

*Corn Stover (Pride of the North).*

[Experiment Station, 1890.]

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 21.76 | 435.20 | - | - | 1:8.61 |
| Dry matter, | 78.24 | 1,564.80 | - | - | |
| | 100.00 | 2,000.00 | - | - | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 3.97 | 79.40 | - | - | |
| " cellulose, | 34.96 | 699.20 | 503.42 | 72 | |
| " fat, | 1.54 | 30.80 | 23.10 | 75 | |
| " protein (nitrogenous matter), | 9.76 | 195.20 | 142.50 | 73 | |
| Non-nitrogenous extract matter, | 49.77 | 995.40 | 666.92 | 67 | |
| | 100.00 | 2,000.00 | 1,335.94 | - | |

*Ensilage Corn (Pride of the North).*

[Sept. 8, 1890.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 9.42 |
| Dry matter, | 90.58 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 6.01 |
| " cellulose, | 23.03 |
| " fat, | 2.76 |
| " protein (nitrogenous matter), | 9.31 |
| Non-nitrogenous extract matter, | 58.89 |
| | 100.00 |

*Ensilage of Soja Bean and Cow-pea.*

[Station, 1889.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 69.78 |
| Dry matter, | 30.22 |
| | 100.00 |

*Analysis of Dry Matter.*

| | Per Cent. |
|---|---|
| Crude ash, | 14.96 |
| " cellulose, | 31.53 |
| " fat, | 4.44 |
| " protein (nitrogenous matter), | 12.47 |
| Non-nitrogenous extract matter, | 36.60 |
| | 100.00 |

*Fertilizing Constituents of Soja Bean and Cow-pea Ensilage.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 9.780 |
| Calcium oxide, | 0.263 |
| Magnesium oxide, | 0.786 |
| Ferric oxide, | 0.369 |
| Sodium oxide, | 1.213 |
| Potassium oxide (4½ cents per pound), | 1.378 |
| Phosphoric acid (6 cents per pound), | 0.812 |
| Nitrogen (17 cents per pound), | 1.800 |
| Insoluble matter, | 4.777 |
| Valuation per ton, | $8 46 |

*Ensilage of Red-cob Corn.*

[Station, 1889.]

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 74.48 | 1,489.60 | – | – | 1 : 13.68 |
| Dry matter, | 25.52 | 510.40 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.55 | 131.00 | – | – | |
| " cellulose, | 28.48 | 569.60 | 410.11 | 72 | |
| " fat, | 4.81 | 96.20 | 72.15 | 75 | |
| " protein (nitrogenous matter), | 6.55 | 131.00 | 95.63 | 73 | |
| Non-nitrogenous extract matter, | 53.61 | 1,072.20 | 718.37 | 67 | |
| | 100.00 | 2,000.00 | 1,296.26 | – | |

*Ensilage of Pride of North Corn.*

| | Percentage Composition. | Constituents (in Pounds) in a Ton of 2,000 Pounds. | Pounds Digestible in a Ton of 2,000 Pounds. | Per Cent. of Digestibility of Constituents. | Nutritive Ratio. |
|---|---|---|---|---|---|
| Moisture at 100° C., | 71.41 | 1,428.20 | – | – | 1 : 10.17. |
| Dry matter, | 28.59 | 571.80 | – | – | |
| | 100.00 | 2,000.00 | – | – | |
| *Analysis of Dry Matter.* | | | | | |
| Crude ash, | 6.41 | 128.20 | – | - | |
| " cellulose, | 24.19 | 483.80 | 348.34 | 72 | |
| " fat, | 5.53 | 110.60 | 82.95 | 75 | |
| " protein (nitrogenous matter), | 8.72 | 174.40 | 127.31 | 73 | |
| Non-nitrogenous extract matter, | 55.15 | 1,103.00 | 739.01 | 67 | |
| | 100.00 | 2,000.00 | 1,297.61 | – | |

*Imported Seed of Scotch Tares.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 14.26 |
| Dry matter, | 85.74 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 4.15 |
| " cellulose, | 3.87 |
| " fat, | 7.38 |
| " protein (nitrogenous matter), | 32.08 |
| Non-nitrogenous extract matter, | 52.52 |
| | 100.00 |

*Fertilizing Constituents of the Above.*

| | |
|---|---|
| Moisture at 100° C, | 14.26 |
| Calcium oxide, | 0.20 |
| Magnesium oxide, | 0.14 |
| Ferric oxide, | 0.02 |
| Sodium oxide, | 0.40 |
| Potassium oxide, | 1.29 |
| Phosphoric acid, | 1.02 |
| Nitrogen, | 4.24 |
| Insoluble matter, | 0.04 |
| Valuation per ton, | $16 74 |

*Vetch and Oats.*

[Station, collected July 23, 1890.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 79.26 |
| Dry matter, | 20.74 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 7.25 |
| " cellulose, | 31.73 |
| " fat, | 3.37 |
| " protein (nitrogenous matter), | 7.70 |
| Non-nitrogenous extract matter, | 49.95 |
| | 100.00 |

*Fertilizing Constituents of Vetch and Oats.*

| | |
|---|---|
| Moisture at 100° C., | 5.78 |
| Calcium oxide, | 0.91 |
| Magnesium oxide, | 0.29 |
| Ferric oxide, | 0.02 |
| Sodium oxide, | 0.64 |
| Potassium oxide, | 2.24 |
| Phosphoric acid, | 0.63 |
| Nitrogen, | 1.16 |
| Insoluble matter, | 0.83 |
| Valuation per ton, | $6 72 |

*Royal English Horse and Cattle Condiment.*

[I., from S. N. Thompson, Southborough, Mass.; II., from C. H. Heywood, Holyoke, Mass.]

| | Per Cent. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 10.30 | 10.82 |
| Dry matter, | 89.70 | 89.18 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 6.53 | 8.57 |
| " cellulose, | 3.59 | 4.52 |
| " fat, | 6.23 | 5.43 |
| " protein (nitrogenous matter), | 14.21 | 13.73 |
| Non-nitrogenous extract matter, | 69.44 | 67.75 |
| | 100.00 | 100.00 |

*Harvey's Universal Vegetable Food.*

[Sent on by E. F. Richardson, Millis, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.18 |
| Dry matter, | 88.82 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 4.59 |
| " cellulose, | 7.06 |
| " fat, | 3.03 |
| " protein (nitrogenous matter), | 15.34 |
| Non-nitrogenous extract matter, | 69.98 |
| | 100.00 |
| Passed screen 144 meshes to square inch, | 72.98 |

*Methods of Analysis of Cattle Foods.*

*1. Moisture.* — Dry 2 grams in an air-bath at 100–110° C. to a constant weight.

*2. Ash.* — Char 2 to 5 grams in a muffle furnace at a low red heat, cool and weigh. Digest for a short time with dilute hydrochloric acid; collect the residue insoluble in acid in a Gooch crucible, wash, dry and weigh. Substract this from the total weight for pure ash.

*3. Ether Extract.* — Dry 2 grams at 100° C. for two hours. Exhaust with anhydrous, alcohol-free ether, until the extraction is complete. Dry the extract in the air-bath at 100° C. to a constant weight.

*4. Crude Protein.* — Determine nitrogen by the Kjeldahl or soda-lime method, and multiply the result by 6.25 for crude protein.

*5. Albuminoid Nitrogen.* — Determine by Stutzer's method, as given in the "Proceedings of the Association of Official Agricultural Chemists," 1889 (pages 226 and 227), except that the protein-copper is dried before being introduced into the flask.

*6. Crude Fibre, or Cellulose.* — The Weende method, as described in the "Proceedings of the Association of Official Agricultural Chemists," 1888 (page 70). In this method 2 grams of the material, having been nearly or completely freed from fat, are boiled for thirty minutes with 200 cubic

centimetres of $1\frac{1}{4}$ per cent. sulphuric acid, brought upon a linen filter and thoroughly washed with boiling water. It is then washed into the boiling-flask with a $1\frac{1}{4}$ per cent. solution of sodium hydrate, brought quickly to 100° C., and boiled for thirty minutes, when it is filtered through a Gooch crucible, or balanced filter-papers, washed with boiling water, alcohol and ether, dried at 100° C. for an hour, and weighed. The organic matter is then burned off, and the weight of the ash deducted for crude cellulose.

# ON FIELD EXPERIMENTS.

V. Some suggestions regarding the question, How can we improve in an economical way the productiveness of our farm lands?

VI. Experiments to ascertain the effect of different combinations of nitrogen, nitrate of soda, sulphate of ammonia and organic-nitrogen-containing materials, blood, as well as the absence of nitrogen-containing manurial matter, under otherwise corresponding circumstances, on oats. (Field A.)

VII. Field experiments with prominent grasses and leguminous plants, to study their composition and general economical value in our section of the country. (Field B.)

VIII. Field experiments with reputed field and garden crops, to ascertain their adaptation to our soil and climate. (Fields C and D.)

IX. Field experiments to study the economy of using different commercial sources of phosphoric acid for manurial purposes in farm practice. (Potatoes. Field F.)

X. Experiments with grass land. (East Field Meadow.)

XI. Report on general farm work.

XII. Professor Humphrey's report. (On diseases of farm plants.)

## V. Some Suggestions regarding the Question, How can we improve in an Economical Way the Productiveness of our Farm Lands?

An insufficient supply of suitable manurial matter, required for the successful and liberal production of the crops to be raised, is at present universally recognized as being the most fatal circumstance in any system of farming for profit. Adopting this conclusion as the correct verdict of past and present experience in agricultural industries, it becomes most desirable, in the interest of satisfactory pecuniary returns, that every available manurial resource of the farm should be turned to account to its full extent. To secure

this end we are advised to begin the work with a timely, thorough, mechanical preparation of the soil under cultivation; to select the crops to be raised, as far as practicable, with reference to their tendency of economizing existing natural resources of plant-food; to increase the latter to the full extent of suitable home-made manure on hand, and to supplement the latter liberally by buying commercial concentrated fodder articles and commercial fertilizer, as far as circumstances advise. To discuss briefly some of the means of developing and economizing manurial sources of the farm, is one of the objects of this communication. On the present occasion only two of those means will be discussed, which, although more or less at the disposition of every farmer engaged in mixed farm management, quite frequently do not receive that degree of consideration which they deserve, namely: —

1. A judicious selection and a liberal production of fodder crops.
2. An economical system of feeding farm live stock.

### 1. *Production and Selection of Fodder Crops.*

A careful inquiry into the history of agriculture, down to the middle of the present century, has shown that the original productiveness of farm lands in all civilized countries, even in the most favored localities, has suffered in the course of time a gradual decline. This general decline in the fertility of the soil under cultivation has been ascribed, with much propriety in the majority of instances, mainly to two causes: namely, a gradual but serious reduction in the area occupied by forage crops, natural pastures and meadows; and a marked decline in the annual yield of fodder upon large tracts of land but ill suited for a permanent cultivation of grasses, — the main reliance of fodder production at the time. A serious falling off in the annual yield of pastures and meadows was followed usually by a reduction in farm live stock, which, in turn, caused a falling off in the principal home resource of manurial matter. This chapter in the history of farm management has repeated itself in most countries. The unsatisfactory results of that system of

farming finds still an abundant illustration in the present exhausted condition of a comparatively large area of farm lands in New England.

Scientific investigations, carried on during the past fifty years for the particular benefit of agriculture, have not only been instrumental in recognizing the principal causes of an almost universal periodical decline of the original fertility of farm lands, but have also materially assisted, by field experiments and otherwise, in introducing efficient remedies to arrest the noted decline in the annual yield of our most prominent farm crops. As a scanty supply of manurial matter, due to a serious falling off of one of the principal fodder crops, was found to be one of the chief causes of less remunerative crops, and thus indirectly has proved to be the main cause of an increase in the cost of the products of the animal industry of the farm, — milk and meat, — it is but natural that the remedies devised should include, as one of the foremost recommendations, a more liberal production of nutritious fodder crops. The soundness of this advice is to-day fully demonstrated in the most successful agricultural regions of the world. An intensive system of cultivation has replaced in those localities the extensive one of preceding periods; although the area under cultivation for the production of general farm crops has been reduced, the total value of products of the farm have increased materially, in consequence of a more liberal cultivation of reputed fodder crops. The change has been gradual, and the results are highly satisfactory.

Viewing our own present condition, we notice that well-paying grass land, good natural meadow, with rich and extensive pastures, are rather an exception than the rule. The benefits derived from indifferently yielding natural pastures are more apparent than real; the low cost of the production of the fodder is frequently, in a large degree, set off by a mere chance distribution of the manure produced. A continued cultivation of one and the same crop upon the same land, without a liberal, rational system of manuring, has caused in many instances a one-sided exhaustion of the land under cultivation. This circumstance has frequently been brought about, in a marked degree, by a close

rotation of mixed grasses (meadow growth) and of our next main reliance for fodder, — the corn (maize). Both crops require potash and phosphoric acid, in similar proportion (4, potassium oxide, to 1, phosphoric acid), and both require an exceptional amount of the former. There is good reason to assume that the low state of productiveness of many of our farms, so often complained of, is largely due to the fact that crops have been raised in succession for years, which, like those mentioned, have consumed one or the other essential article of plant food in an exceptionally large proportion, and thereby have gradually unfitted the soil for their remunerative production; while a liberal supply of other important articles of plant food is left inactive behind. As the amount of available plant food contained in the soil represents largely the working capital of the farmer, it cannot be otherwise but that the practice of allowing a part of it to lie idle must reduce the interest on the investment.

Our personal observation upon the lands assigned for the use of the station has furnished abundant illustration of the above-described condition of farm lands. In one instance it was noticed that a piece of old, worn-out grass land, after being turned under and properly prepared, as far as the mechanical condition of the soil was concerned, produced, without any previous application of manure, an exceptionally large crop of horse-beans and lupine, — two reputed fodder crops. A similar observation was made during the past season, when lands, which for years had been used for the production of English hay and corn, were used for the cultivation of southern cow-pea, serradella, and a mixed crop of oats and vetch, to serve as green fodder for milch cows. The field engaged for the production of these crops was not manured, because it was to be prepared for a special field experiment during the present season. An area of this land, which, under favorable circumstances, would not produce more than six tons of green grass at the time of blooming, yielded nine to ten tons of green vetch and oats, ten tons of green southern cow-pea, and from twelve to thirteen tons of green serradella. The exceptional exhaustion of our lands in potash has been shown by detailed descrip-

tion of experiments with fodder corn in previous annual reports.

The results obtained during past years tend to confirm the opinion held by successful agriculturists, that dry grass lands which are in an exceptional degree inclined to a spontaneous overgrowing by an inferior class of fodder plants and weeds, if at all fit for a more thorough system of cultivation, ought to be turned by the plough and subsequently planted with some hoed crop, to kill off the foul growth and to improve the physical and chemical condition of the soil. These lands prove, in many instances, ultimately a far better investment when used for the raising of other farm crops than grasses. The less the variety of crops raised in succession upon the same lands, the more one-sided is usually the exhausted soil, and the sooner, as a rule, will be noticed a decrease in the annual yield. The introduction of a greater variety of fodder plants enables us to meet better the differences in local conditions of climate and of soil, as well as the special wants of different branches of farm industry. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc , is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range, for the introduction of economical systems of rotation, under various conditions of soil and different requirements of markets. Most of these fodder plants have an extensive root system, and for this reason largely draw their plant food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to cultivation is

reduced, the total yield of the land is usually more satisfactory.

The subsequent tabular statement contains a list of fodder crops raised on the lands of the station. Those marked with * have been tried successfully on a large scale for fodder; the remainder seem to be well adapted to our climate. All are reported in their *dry* state, to compare their relative nutritive character, as well as the value of their fertilizing constituents. For further details, see seventh annual report, for 1889.

*Composition of Fodder Crops raised upon the Station Grounds.*

| NAME OF CROP. (SUITABLE FOR FEEDING.) | Nutritive Ratio. | Fodder Constituents (in Pounds) in 1,000 Pounds of Dry Matter. | | | | | Fertilizing Constituents (in Pounds) in 1,000 Pounds of Dry Matter. | | | Manurial Value per Ton of Dry Matter. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Crude Ash. | Crude Cellulose. | Crude Fat. | Crude Protein (Nitrogenous Matter). | Non-nitrogenous Extract Matter. | Nitrogen. | Phosphoric Acid. | Potassium Oxide. | |
| Medium clover (*Trifolium pratense*), | | 89.0 | 299.7 | 26.2 | 146.3 | 438.8 | 23.40 | 4.88 | 24.65 | $10 64 |
| Alsike clover (*Trifolium hybridum*), | | 116.7 | 261.8 | 26.6 | 162.2 | 432.7 | 25.88 | 7.81 | 24.72 | 11 86 |
| *Cow-pea (*Dolichos*), | 1 : 2.5 | 69.2 | 235.9 | 24.8 | 145.9 | 521.2 | 23.40 | 5.79 | 14.44 | 9 86 |
| *Serradella (*Ornithopus sativus*), | to | 116.9 | 324.9 | 23.7 | 149.6 | 384.9 | 23.94 | 8.04 | 24.12 | 11 15 |
| *Vetch (*Vicia sativa*), | 1 : 5.5 | 82.4 | 303.7 | 25.0 | 150.9 | 438.0 | 24.14 | 5.47 | 12.75 | 9 95 |
| *Soja bean (*Soja hispida*), | | 75.1 | 212.6 | 59.9 | 154.0 | 497.5 | 24.78 | 4.66 | 16.53 | 10 39 |
| Lucerne (*Medicago sativa*), | | 81.1 | 297.2 | 16.5 | 142.2 | 463.0 | 22.75 | 5.61 | 15.59 | 9 73 |
| *Herds grass (*Phleum pratense*), | | 53.3 | 328.7 | 20.1 | 85.2 | 512.7 | 13.95 | 4.97 | 16.54 | 6 75 |
| *Corn stover, | | 50.3 | 320.2 | 16.5 | 79.2 | 533.8 | 12.67 | 4.22 | 18.39 | 6 38 |
| *Fodder corn, | | 48.8 | 314.0 | 15.3 | 72.1 | 549.8 | 11.54 | 7.38 | 10.99 | 5 75 |
| *Oats (entire plant), | 1 : 5.5 | 60.8 | 343.2 | 26.9 | 108.9 | 460.2 | 17.42 | 7.81 | 22.90 | 8 81 |
| Barley (entire plant), | to | 49.5 | 291.2 | 27.6 | 102.6 | 529.1 | 16.42 | 6.44 | 19.53 | 8 02 |
| Millet, | 1 : 9.5 | 54.9 | 335.4 | 17.4 | 75.9 | 516.4 | 12.14 | 5.03 | 10.89 | 5 66 |
| Hungarian grass (*Setaria italica*), | | 71.5 | 246.6 | 10.1 | 93.8 | 578.0 | 15.01 | 6.24 | 13.50 | 7 00 |
| Japanese buckwheat, | | 123.6 | 360.2 | 22.2 | 108.0 | 386.0 | 17.28 | 9.04 | 35.21 | 9 95 |
| *Sugar beets, | 1 : 9.5 | 46.4 | 60.0 | 6.5 | 108.4 | 778.7 | 17.34 | 5.41 | 18.57 | 8 12 |
| *Ruta-bagas, | to | 97.5 | 118.3 | 15.3 | 110.1 | 658.8 | 17.62 | 10.76 | 41.05 | 10 77 |
| *Mangel-wurzels, | 1 : 13. | 90.6 | 79.4 | 8.8 | 103.7 | 717.5 | 16.59 | 7.32 | 30.13 | 9 08 |
| *Carrots, | | 81.4 | 95.3 | 25.0 | 88.4 | 709.9 | 14.14 | 10.02 | 54.11 | 10 61 |

### 2. *Economical Feeding of Farm Live Stock.*

The adoption of an economical system of feeding farm live stock in the case of a mixed farm management is only second in importance, as far as financial success is concerned, to the remunerative production of the leading farm crops. The benefits derived from a successful management of the latter are not unfrequently largely offset by a mismanagement of the former. Comparatively recent investigations, regarding the principles which control success in feeding farm live stock for various purposes, have greatly improved our chances for profit. Although much needs still to be learned in regard to many details, it is quite generally conceded that some important facts, bearing on the economical side of the question, have been fairly established.

The introduction of the chemical analysis of fodder articles has made us more familiar with their general character. The influences which affect their composition are also better known. A fair knowledge in both directions is to-day considered indispensable for a due appreciation of the results obtained in feeding experiments. The latter, carried on under better-defined circumstances, have demonstrated the important fact that three distinctly different groups of substances are required for the support of the life of animals. These groups are: nitrogen-containing organic substances, commonly called nitrogenous organic matter; non-nitrogenous organic matter, like sugar, starch, fat, etc.; and certain saline or mineral substances. Neither one nor two of these groups by themselves can for any length of time sustain animal life; nor can any excess of one or the other, contained in the diet used, benefit the animal. The excess, as a rule, is ejected, and can only, if at all, benefit the manure. We know, also, that all our farm plants contain more or less of each of the three essential groups of food constituents. As no single plant or part of plant has proved to any extent to furnish the most nutritious and at the same time the most economical diet for any particular class of animals, it becomes advisable to supplement them with other suitable articles, to secure their full benefit. An economical system of stock feeding has, therefore, to strive

to select among the suitable fodder articles those which furnish the required quantity and proportion of the three essential food constituents in digestible form at the lowest cost. For more details regarding this point, I have to refer to previous annual reports.

Assuming a similar degree of adaptation of the various fodder articles offered for our choice, the question of cost deserves a serious consideration, when feeding for profit. The actual cost of a fodder article does not depend merely upon its market price, but is materially affected by the value of the manurial refuse it leaves behind, when it has served its purpose as food. The higher the percentage of nitrogen, phosphoric acid and potash a diet contains, the more valuable is the manure it furnishes, under otherwise corresponding circumstances. An excess, therefore, of any one or of all three in one diet, as compared with that of another, counts in favor of that particular diet, as far as the net cost of feed is concerned; for it is admissible, for mere practical economical purposes, to assume that, in raising one and the same kind of animals to a corresponding weight, or feeding them for the same purpose, a corresponding amount of nitrogen, phosphoric acid, potassium oxide, etc., will be retained, and, according to circumstances, either stored up in the growing animal, or pass into the milk, etc. The commercial value of the three above-mentioned essential articles of plant food, contained in the manure secured in connection with our feeding experiments with milch cows, has differed in case of different diets from less than one-third to more than one-half of the market cost of feed consumed. A few tabular statements may not be without interest on this occasion; for further illustration, I refer to our seventh annual report, — 1889.

1. Table showing the relative manurial value of stated fodder. Net cost signifies market cost, less manurial value.

2. Tables designed to show the approximate relative cost per pound of digestible nitrogenous matter of some prominent fodder articles. The calculation assumes in every case a value of nine-tenths cents per pound of digestible non-nitrogenous extract matter, and four and one-third cents for digestible crude fat. The difference between

the sum of the money values of fat and non-nitrogenous extract matter and cellulose present, and the market price of the particular fodder articles, is charged to the digestible nitrogenous matter. The corn meal has been adopted as the basis for the comparison, as far as value of non-nitrogenous matter is concerned. In presenting this table, it is by no means assumed that the nitrogenous matter, as stated below, is pound for pound of equal nutritive value; it merely aims to show what class of articles suggest themselves for trials, when an increase of nitrogenous matter is the main object for consideration in making up a class suitable for the occasion.

*1. Valuation of Fodder Articles (per Ton).*

| | Market Cost. | Manurial Value. | Net Cost. |
|---|---|---|---|
| Corn meal, | $20 00 | $7 50 | $12 50 |
| Wheat bran, | 17 00 | 14 50 | 2 50 |
| Wheat middlings, | 20 00 | 10 75 | 9 25 |
| Gluten meal, | 24 00 | 17 00 | 7 00 |
| Cotton-seed meal, | 26 00 | 19 75 | 6 25 |
| Linseed meal (old-process), | 27 00 | 21 75 | 5 25 |
| Linseed meal (new-process), | 25 00 | 24 00 | 1 00 |
| English hay (mixed), | 12 00 | 5 50 | 6 50 |
| Corn fodder, | 5 00 | 4 32 | 0 68 |
| Corn stover, | 5 00 | 4 80 | 0 20 |
| Sugar beets, | 5 00 | 1 15 | 3 85 |
| Mangel-wurzels, | 3 00 | 1 10 | 1 90 |
| Skim-milk, | 4 10 | 2 25 | 1 85 |

## 2. *Cost of Digestible Nitrogenous Matter of Fodder Articles (per Pound).*

[The constituents are given in pounds per 1,000 pounds of the substance which contains them.]

| | Market Cost per Ton. | Moisture at 100° C. | Dry Matter. | Total Nitrogenous Matter. | Rate of Digestibility. Approximate values. | Digestible Nitrogenous Matter (Pounds). | Indigestible Nitrogenous Matter (Pounds). | Cost of Digestible Nitrogenous Matter per Pound, allowing for Digestible Fat Four and One-third Cents, for Cellulose and Non-nitrogenous Extract Matter Nine-tenths Cents, per Pound. | Total Nitrogen in Article. | Digestible Nitrogen. | Indigestible Nitrogen. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Cents. | | | |
| Corn meal, | $20 00 | 128.6 | 871.4 | 98.47 | 85 | 83.70 | 14.77 | 3.30 | 15.66 | 13.31 | 2.35 |
| Wheat bran, | 17 00 | 109.7 | 890.3 | 158.36 | 88 | 139.36 | 19.00 | 2.21 | 25.33 | 22.29 | 3.04 |
| Wheat middlings, | 20 00 | 95.5 | 904.5 | 164.71 | 88 | 144.94 | 19.77 | 3.08 | 26.35 | 23.19 | 3.16 |
| Gluten meal, | 24 00 | 96.1 | 903.9 | 289.88 | 85 | 246.40 | 43.48 | 2.20 | 46.38 | 39.42 | 6.96 |
| Cotton-seed meal, | 26 00 | 80.8 | 919.2 | 388.09 | 74 | 287.20 | 100.89 | 2.41 | 62.09 | 45.95 | 16.14 |
| Linseed meal (old-process), | 27 00 | 74.8 | 925.2 | 343.70 | 87 | 299.02 | 44.68 | 2.50 | 54.99 | 47.84 | 7.15 |
| Linseed meal (new-process), | 25 00 | 60.1 | 939.9 | 383.08 | 87 | 333.28 | 49.80 | 2.40 | 61.29 | 53.32 | 7.97 |
| Timothy hay, | 12 00 | 85.7 | 914.3 | 75.97 | 57 | 43.30 | 32.67 | 3.10 | 12.15 | 6.93 | 5.22 |
| English hay (mixed), | 12 00 | 97.2 | 902.8 | 86.13 | 57 | 49.09 | 37.04 | 3.09 | 13.78 | 7.85 | 5.93 |
| Corn fodder, | 5 00 | 200.0 | 800.0 | 57.68 | 73 | 42.10 | 15.58 | –* | 9.23 | 6.74 | 2.49 |
| Corn stover, | 5 00 | 162.7 | 837.3 | 68.74 | 73 | 50.18 | 18.56 | –* | 11.00 | 8.03 | 2.97 |
| Sugar beets, | 5 00 | 835.2 | 164.8 | 19.17 | 100 | 19.17 | 0.00 | 6.47 | 3.07 | 3.07 | 0.00 |
| Mangel-wurzels, | 3 00 | 877.5 | 122.5 | 12.70 | 100 | 12.70 | 0.00 | 4.52 | 2.03 | 2.03 | 0.00 |
| Skim-milk, | 4 10 | 904.2 | 95.8 | 33.27 | 100 | 33.27 | 0.00 | 4.39 | 5.32 | 5.32 | 0.00 |

* The digestible fat, cellulose and non-nitrogenous extract matter at stated prices more than cover the market cost.

### *Corn Ensilage (Six Samples).*

[Sent on by J. H. Esterbrook for the Dudley Grange.]

*Statements of Parties.*

*a.* Variety of corn: —

1. Cross between Stowell's evergreen and eight-rowed variety.
2. Common field.
3. Eureka ensilage.
4. Southern white.
5. Stowell's evergreen.
6. Southern white.

*b.* Fertilization per acre: —

1. Three cords stable manure broadcast, with five hundred pounds ground bone in hill.
2. About thirty loads or ten cords stable manure broadcast, and two hundred pounds phosphate in hill.
3. Forty loads stable manure broadcast.
4. After a crop of rye for fodder, with five cords stable manure, four hundred pounds E. F. Coe's phosphate in drill.
5. Six cords horse manure, with three hundred pounds Bradley's fish in hill.
6. Two and one-half cords stable manure broadcast, on grass sod in the fall, and ploughed in with four hundred pounds of phosphate in drill when planting.

*c.* Mode of planting: —

1. Rows three feet apart; hills twenty-six inches apart; four kernels to hill.
2. Rows three and a half feet apart; hills twenty inches apart.
3. Rows three feet apart; hills twelve inches apart.
4. Rows three feet apart; kernels about three inches apart in drills.
5. Rows thirty-two inches apart; kernels about six inches apart in drills.
6. Rows three feet apart; kernels about one foot apart in drills.

*d.* Period of harvesting: —

1. Somewhat past the milk.
2. Over ripe; rather dry (September 23).
3. In the milk.
4. Ears commencing to form in the more exposed parts of the field.
5. Ears ripe enough for seed.
6. Past the milk (September 25).

*e.* Yield per acre (approximately): —

1. Eighteen to twenty tons.

2. About eight tons of ensilage and eighty bushels of ears.
Estimated, thirty-five to forty tons; ten to fifteen feet high.
4. Twelve tons.
5. Twenty to twenty-two tons.
6. Twelve tons.

*f.* Mode of ensilaging: —
1. Cut in short pieces; silo filled in two days.
2. Cut in pieces one inch long.
3. Cut in short pieces by a Bailey cutter.
4. Cut in pieces one inch long by a Bailey cutter; covered with twelve inches of old hay or straw; then with inch boards and ten inches thickness of stones.
5. Cut in pieces three to four inches long by a Bailey cutter; silo filled in two days, covered and weighted.
6. Same as 4.

*g.* Fodder analysis: —

| Sample. | Acidity calculated to Acetic Acid. | Moisture at 100° C. | Dry Matter. | Analysis of Dry Matter, 100 Parts. | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Crude Ash. | Crude Cellulose. | Crude Fat. | Crude Protein (Nitrogenous Matter). | Non-nitrogenous Extract Matter. |
| | Per Cent. | Per Cent. | Per Cent. | | | | | |
| No. 1, . | 3.68 | 76.38 | 23.62 | 6.18 | 20.05 | 5.57 | 8.49 | 59.71 |
| No. 2, . | 2.12 | 70.01 | 29.99 | 6.74 | 34.97 | 2.74 | 5.98 | 49.57 |
| No. 3, . | 1.98 | 82.87 | 17.13 | 7.22 | 38.92 | 1.82 | 6.04 | 46.00 |
| No 4, . | 2.69 | 75.36 | 24.64 | 6.25 | 30.26 | 2.57 | 6.52 | 54.40 |
| No. 5, . | 1.27 | 78.84 | 21.16 | 6.94 | 24.40 | 3.78 | 7.53 | 57.35 |
| No. 6, . | 1.13 | 71.65 | 28.35 | 4.37 | 24.64 | 2.68 | 6.82 | 61.49 |

*Observations made at the Laboratory.*

No. 1. Best-looking sample, bright and fresh. Good per cent. of ears. Agreeable acid odor.

No. 2. Odor and appearance not as good as No. 1. Smaller per cent. of ears.

No. 3. Small per cent. of ears. Bright looking. Odor slightly sour.

No. 4. Fair per cent. of ears. Odor agreeable, but slightly sour. Not so bright looking as No. 1.

No. 5. Larger per cent. of ears. Odor agreeable. Color, fair. Small weeds and grass mixed in.

No. 6. Fair per cent. of ears. Color not as bright as No. 1. Smell, fair.

## VI. Field Experiments to ascertain the Effect of Different Combinations of Nitrogen, Nitrate of Soda, Sulphate of Ammonia and Organic-nitrogen-containing Compounds, Blood, under Otherwise Corresponding Circumstances, on Oats. 1890. (Field A.)

The area occupied by this experiment is the same which has served during four preceding years in succession — 1884 to 1888 — for the purpose of ascertaining the extent of the inherent natural resources of potash. The results obtained in that connection, which are described in our third, fourth, fifth and sixth annual reports, left no doubt about the fact that our farm land had been in an exceptional degree impoverished in potash, in consequence of a too close rotation of grass and corn.

The field record of each of the ten plats, one-tenth of an acre in size, extended over a period of more than six years, as far as modes of cultivation and of manuring are concerned. Some plats had received during that period a supply of nitrogen for manurial purposes in but one and the same specified form, while others had received none in any form. This condition of the various plats was turned to proper account in our new plans.

*1889* — Several plats which for five preceding years did not receive any nitrogen compound for manurial purposes, were retained in that state to study the effect of an entire exclusion of nitrogen-containing manurial substances on the crop under cultivation; while the remaining ones received, as before, a definite amount of nitrogen in the same form in which they had received it in preceding years; namely, either as sodium nitrate or as ammonium sulphate, or as organic nitrogenous matter in form of dried blood. A corresponding amount of available nitrogen was applied in all these cases.

Aside from the difference regarding the nitrogen supply, all plats were treated alike. They each received, without an exception, a corresponding amount of available phos-

phoric acid and of potassium oxide. The phosphoric acid was supplied in form of dissolved bone-black, and the potassium oxide either in form of muriate of potash or of potash-magnesia sulphate. From 120 to 130 pounds of potassium oxide, from 80 to 85 pounds of available phosphoric acid, and from 40 to 50 pounds of available nitrogen, were supplied per acre.

One plat, marked 0, received its main supply of phosphoric acid, potassium oxide and nitrogen in form of barn-yard manure; the latter was carefully analyzed before being applied, to determine the amount required to secure, as far as practicable, the desired corresponding proportion of essential fertilizing constituents. The deficiency in potassium oxide and phosphoric acid was supplied by potash-magnesia sulphate and dissolved bone-black. The fertilizer for this plat consisted of 800 pounds of barn-yard manure, 32 pounds of potash-magnesia sulphate, and 18 pounds of dissolved bone-black.

Plats 4, 7 and 9 received no nitrogen-containing manurial substance; plats 1 and 2 received nitrogen in form of sodium nitrate; plats 5, 6 and 8 received nitrogen in form of ammonium sulphate; plats 3 and 10 received nitrogen in form of dried blood; plat 0 received nitrogen in form of barn-yard manure.

The entire field, eleven plats, was ploughed April 9. The fertilizer was applied broadcast to each plat, and subsequently slightly harrowed under, April 27. The final preparation of the soil for seeding, by ploughing and harrowing, took place May 9. The same variety of corn (Clark), a flint corn, was planted in drills in a similar manner as during preceding years, May 10. The crop on all plats was kept clean by means of the cultivator and hoe; it was cut September 3, when the kernels were fairly glazed over.

*Yield of Corn Stover and Ears on Plats (1889), at Forty-eight Per Cent. Moisture.*

| | Weight of Whole Crop. | Weight of Stover. | Weight of Ears. | Form of Nitrogen applied. |
|---|---|---|---|---|
| | Pounds. | Pounds. | Pounds. | |
| Plat 0, . . | 500.62 | 342.35 | 158.27 | Barn-yard manure. |
| Plat 1, . . | 648.48 | 475.95 | 172 53 | Nitrate of soda. |
| Plat 2, . . | 576 91 | 375.75 | 201.16 | Nitrate of soda. |
| Plat 3, . . | 618.31 | 425 85 | 192.46 | Blood. |
| Plat 4, . . | 381.18 | 283.90 | 97 28 | No nitrogen. |
| Plat 5, . . | 488.01 | 359 05 | 128.96 | Ammonium sulphate. |
| Plat 6, . . | 541.95 | 367.05 | 174.90 | Ammonium sulphate. |
| Plat 7, . . | 525.82 | 484 30 | 41.52 | No nitrogen. |
| Plat 8, . . | 359.12 | 237.98 | 121.14 | Ammonium sulphate. |
| Plat 9, . . | 475.63 | 417.50 | 58.13 | No nitrogen. |
| Plat 10, . . | 639 55 | 467.60 | 171.95 | Dried blood. |

*Percentage of Well-developed and Undeveloped Ears on Plats (1889).*

| | Well-developed Ears. | Undeveloped Ears. |
|---|---|---|
| | Per Cent | Per Cent. |
| Plat 0, . . . . . . . | 60 3 | 39.7 |
| Plat 1, . . . . . . . | 48.5 | 51.5 |
| Plat 2, . . . . . . . | 46 7 | 53.3 |
| Plat 3, . . . . . . . | 28.3 | 71.7 |
| Plat 4, . . . . . . . | 14 7 | 85.3 |
| Plat 5, . . . . . . . | 18.7 | 81 3 |
| Plat 6, . . . . . . . | 29 0 | 71.0 |
| Plat 7, . . . . . . . | 41 6 | 58.4 |
| Plat 8, . . . . . . . | 21.3 | 78.7 |
| Plat 9, . . . . . . . | 24.4 | 75.6 |
| Plat 10, . . . . . . . | 50.2 | 49.8 |

The following tabular statement shows the general condition of the soil and its crop-producing quality during the years 1888 and 1889: —

*Field A.*

| Number of Plat. | Fertilizers Applied. | | Yield of Dry Fodder Corn. | |
|---|---|---|---|---|
| | 1888. | 1889. | 1888. | 1889. |
| Plat 1, . | 50 lbs. muriate of potash (= 25 lbs. potassium oxide), | 25 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . . . . . | 617 | 648 |
| Plat 2, . | 50 lbs. nitrate of soda (= 7 to 8 lbs. nitrogen), . . | 29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . . | 303 | 577 |
| Plat 3, . | 100 lbs. dissolved bone-black (= 17 lbs. available phosphoric acid). | 43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . . . . . . . . . | 150 | 618 |
| Plat 4, . | Nothing, . . . . . . . . . . . . . | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . | 114 | 381 |
| Plat 5, . | 97 lbs. magnesium sulphate, . . . . . . . . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . . | 564 | 488 |
| Plat 6, . | Nothing, . . . . . . . . . . . . . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen). 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . . . . . | 193 | 512 |
| Plat 7, . | 50 lbs. muriate of potash (= 25 lbs. potassium oxide), | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . | 676 | 526 |
| Plat 8, . | 50 lbs. ammonium sulphate (= 10 lbs. nitrogen), . . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . . . . . | 146 | 359 |
| Plat 9, . | 50 lbs. muriate of potash (= 25 lbs. potassium oxide), | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . | 553 | 476 |
| Plat 10, . | 97 lbs. potash-magnesia sulphate (= 25 lbs. potassium oxide) and 60 lbs. dried blood (= 7 to 8 lbs. nitrogen). | 43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid), . . . . . | 737 | 640 |

The results of our first season of observation, 1889, regarding the influence of nitrogen-containing manurial substances on the character and on the quantity of the fodder corn raised under otherwise corresponding circumstances, although not without some interest, were not decisive enough to advise a detailed explanation of causes. The larger part of the summer season of 1889 with us was cold and wet, and for this reason of an exceptionally unfavorable character for the raising of fodder corn. How much this circumstance has affected our first results, is difficult to decide. Not less difficult is it to decide, at this stage of observation, how much the special conditions of various plats may yet control the results. The comparatively low yield of ears and the large percentage of undeveloped ears, on plats 4, 7, 9, which received no nitrogen-containing manurial matter, was, however, very marked.

*1890.* — During the past season, oats was chosen as the crop for our trial. The field was prepared by ploughing in the fall and in the spring, previous to the manuring. The same kind and the same quantity of manurial substances were applied broadcast to the different plats as in the preceding year shortly before seeding.

| NUMBER OF PLAT. | |
|---|---|
| Plat 0, . | 800 lbs. of barn-yard manure, 32 lbs. of potash-magnesia sulphate and 18 lbs. of dissolved bone-black. |
| Plat 1, . | 29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid.) |
| Plat 2, . | 29 lbs. sodium nitrate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 3, . | 43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 4, . | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 5, . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 6, . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 7, . | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 8, . | 22.5 lbs. ammonium sulphate (= 4 to 5 lbs. nitrogen), 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 9, . | 25 lbs. muriate of potash (= 12 to 13 lbs. potassium oxide) and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |
| Plat 10, . | 43 lbs. dried blood (= 5 to 6 lbs. nitrogen), 48.5 lbs. potash-magnesia sulphate (= 12 to 13 lbs. potassium oxide), and 50 lbs. dissolved bone-black (= 8.5 lbs. available phosphoric acid). |

The above weights of the different manurial substances were taken for the purpose of securing to each plat, as far as practicable, potash, phosphoric acid and nitrogen in corresponding proportions.

The manurial substances were slightly harrowed under before seeding. The oats were seeded April 29 and 30, in rows, two feet apart, to allow a one-horse cultivator to pass between the rows. Each plat had sixteen rows, and thirty-nine pounds of oats, Pringle's Progress, were in equal weights divided between eleven plats. A brush seed drill with no plate under the brush was used for that purpose.

The young plants appeared above ground on May 5. The plants on plats 6 and 8 appeared sickly, having a yellowish tint, May 23. The entire field became subsequently somewhat infested with plant lice, plats 6 and 8 suffering most, May 26. Cultivator and hoe were used at this stage, to renovate the ground, June 2 and 3. The entire crop, with the exception of that upon Plat 8, soon improved and recovered entirely. Plat 8 suffered for some days longer than the rest from the infection; it showed later on a lower and somewhat uneven stand of its oats.

The shade of the green of the growth upon different plats showed during the progress of the season in many instances a quite marked difference. Upon plats which had received their nitrogen in the form of sulphate of ammonia, as well as upon those which had received no nitrogen-containing manurial matter, a light-green tint of the foliage was noticed alike in the earlier stages of the growth of the oats. In the latter case this light-green color of the crop remained until the maturing began; in the former case, *i. e.*, where sulphate of ammonia had furnished the nitrogen supply, the color became deeper green as the season progressed.

The progress of growth varied at times in a marked degree, yet no exceptional differences in height were noticeable at the maturing of the crop.

The following tabular statement contains the measurements of the height of the plants at stated dates: —

| | June 20 (Inches). | June 27 (Inches). | July 4 (Inches). | July 11 (Inches). | July 18 (Inches) | July 25 (Inches). |
|---|---|---|---|---|---|---|
| Plat 0, . . | 15 | 20 | 25 | 31 | 36 | 38 |
| Plat 1, . . | 16 | 19 | 25 | 31 | 36 | 36 |
| Plat 2, . . | 15 | 20 | 28 | 33 | 40 | 40 |
| Plat 3, . . | 14 | 17 | 21 | 30 | 34 | 36 |
| Plat 4, . . | 13 | 16 | 22 | 27 | 30 | 33 |
| Plat 5, . | 15 | 19 | 28 | 34 | 38 | 40 |
| Plat 6, . . | 12 | 15 | 22 | 30 | 37 | 40 |
| Plat 7, . . | 12 | 15 | 20 | 28 | 35 | 36 |
| Plat 8, . . | 7 | 11 | 16 | 23 | 32 | 36 |
| Plat 9, . . | 12 | 13 | 21 | 27 | 31 | 35 |
| Plat 10, . . | 14½ | 19 | 24 | 32 | 40 | 40 |

The entire crop was cut August 11; it was removed to the barn August 13. To secure as far as practicable a uniform state of dryness, the final weighing of the yield of each plat was deferred to August 21, when the following results were obtained: —

| | Grain and Straw (Pounds). | Grain (Pounds). | Straw and Chaff (Pounds). |
|---|---|---|---|
| Plat 0, . . . . . | 315 | 120 | 195 |
| Plat 1, . . . . . | 362 | 128 | 234 |
| Plat 2, . . . . . | 365 | 129 | 236 |
| Plat 3, . . . . . | 345 | 116 | 229 |
| Plat 4, . . . . . | 260 | 90 | 170 |
| Plat 5, . . . . . | 360 | 141 | 219 |
| Plat 6, . . . . . | 385 | 124 | 261 |
| Plat 7, . . . . . | 320 | 110 | 210 |
| Plat 8, . . . . . | 220 | 59 | 161 |
| Plat 9, . . . . . | 290 | 101 | 189 |
| Plat 10, . . . . . | 395 | 140 | 255 |
| | 3,617 | 1,258 | 2,359 |

Considering Plat 8 a failure for known cause, the low yield of kernels on plats 4, 7 and 9, which received no nitrogen application, is, to say the least, very significant.

*Comparative Weights and Moisture Tests of the Above-recorded Grains.*

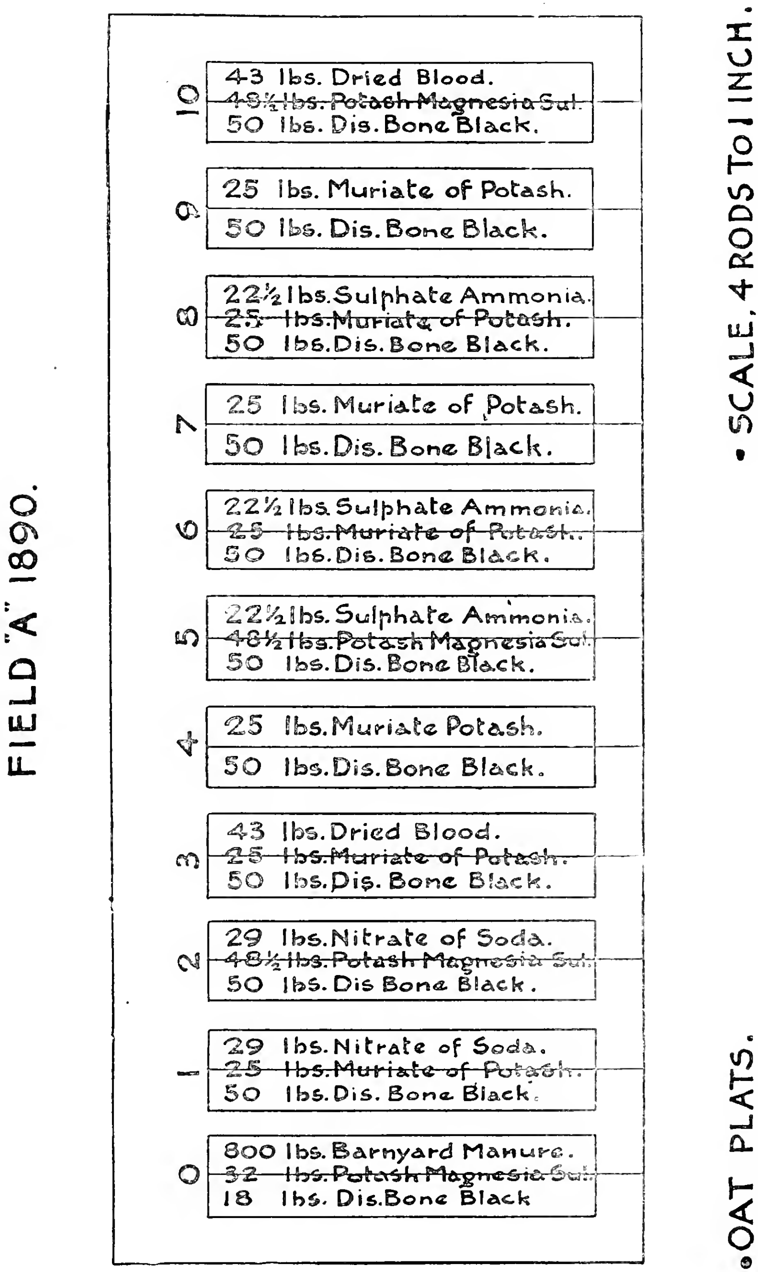
One hundred average kernels of each plat were taken for the test; three independent tests were made; the weights below recorded are the mean of the three tests made. The oats were kept in glass-stoppered bottles during the examination.

| PLATS. | Average Weight of 100 Kernels (Grams). | Average Per Cent. of Water. | Percentage of Dry Matter. |
|---|---|---|---|
| 0, . . . . . . | 3.2151 | 16.96 | 83.04 |
| 1, . . . . . . | 3.3577 | 17.58 | 82.42 |
| 2, . . . . . . | 3.1236 | 17.43 | 82.57 |
| 3, . . . . . . | 3.3260 | 20.88 | 79.12 |
| 4, . . . . . . | 3.2991 | 20.99 | 79.01 |
| 5, . . . . . . | 3.2015 | 18.79 | 81.21 |
| 6, . . . . . . | 3.1201 | 22.60 | 77.40 |
| 7, . . . . . . | 3.3956 | 22.22 | 77.78 |
| 8, . . . . . . | 3.0727 | 17.74 | 82.26 |
| 9, . . . . . . | 3.3408 | 23.94 | 76.06 |
| 10, . . . . . . | 3.0740 | 18.34 | 81.66 |

The difference in moisture points evidently towards some varying degree in maturity. In the majority of cases where muriate of potash has furnished the potassa, the maturing of the crop was somewhat later than where sulphate of potassa was used.

| PLAT. | Crop (Pounds). | Percentage of Grain. | Percentage of Straw and Chaff. | Dry Matter in Grain (Pounds). | Relative Percentage of Dry Matter in Grain. | Analysis of Dry Matter. | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Potassium Oxide. | Phosphoric Acid. | Nitrogen. |
| | | | | | | Per Cent. | Per Cent. | Per Cent. |
| 0, . | 315 | 38.10 | 61.90 | 99.66 | 86.97 | 0.82 | 1.13 | 2.62 |
| 1, . | 362 | 35.36 | 64.64 | 105.50 | 92.13 | 0.76 | 1.21 | 2.75 |
| 2, . | 365 | 35.34 | 64.66 | 106.52 | 93.02 | 0.75 | 1.02 | 2.72 |
| 3, . | 345 | 33.62 | 66.38 | 91.78 | 80.15 | 0.84 | 1.21 | 2.49 |
| 4, . | 260 | 34.61 | 63.39 | 71.11 | 62.09 | 0.79 | 1.08 | 2.53 |
| 5, . | 360 | 39.20 | 60.80 | 114.51 | 100.00 | 0.85 | 0.96 | 2.68 |
| 6, . | 385 | 32.21 | 67.79 | 95.98 | 83.82 | 0.90 | 1.15 | 2.64 |
| 7, . | 320 | 34.40 | 65.60 | 85.56 | 74.72 | 0.80 | 1.06 | 2.36 |
| 8, . | 220 | 26.82 | 73.18 | 48.53 | 42,30 | 0.84 | 1.09 | 2.64 |
| 9, . | 290 | 34.83 | 65.17 | 76.82 | 67.08 | 0.80 | 0.97 | 2.59 |
| 10, . | 395 | 35.44 | 64.56 | 114.33 | 99.84 | 0.84 | 1.18 | 2.59 |
| Average, | 329 | 34.54 | 65.46 | | | | | |

The absence of nitrogen in the manurial matter applied to plats 4, 7, 9, is accompanied by the lowest yield in dry matter in the grain; the yield of dried grain in case of plats 4, 7, 9, averages 67.9 per cent., and in case of the remaining plats, excluding Plat 8 for stated reasons, it averages 90.8 per cent. The plats containing potash-magnesia sulphate as the potash source, namely, plats 2, 5, 10, have yielded the largest amount of grain; each of these plats received its nitrogen supply in a different form, — ammonium sulphate, blood, and nitrate of soda. The field (A) has been seeded with winter rye during the late autumn, to continue the investigation in the same direction.


FIELD "A" 1890.
OAT PLATS.
SCALE, 4 RODS TO 1 INCH.
10
43 lbs. Dried Blood.
48½ lbs. Potash Magnesia Sul.
50 lbs. Dis. Bone Black.
9
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
8
22½ lbs. Sulphate Ammonia.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
7
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
6
22½ lbs. Sulphate Ammonia.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
5
22½ lbs. Sulphate Ammonia.
48½ lbs. Potash Magnesia Sul.
50 lbs. Dis. Bone Black.
4
25 lbs. Muriate Potash.
50 lbs. Dis. Bone Black.
3
43 lbs. Dried Blood.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
2
29 lbs. Nitrate of Soda.
48½ lbs. Potash Magnesia Sul.
50 lbs. Dis Bone Black.
1
29 lbs. Nitrate of Soda.
25 lbs. Muriate of Potash.
50 lbs. Dis. Bone Black.
0
800 lbs. Barnyard Manure.
32 lbs. Potash Magnesia Sul.
18 lbs. Dis. Bone Black

## VII. Field Experiments with Prominent Fodder Crops, to study their Composition and their General Economical Value in our Section of the Country. — Grasses and Leguminous Plants (Field B).

The field here under discussion is located west of Field A, described within some preceding pages. It occupies an area of one and seven-tenths acres. The land is nearly level, and the soil consists of a sandy loam several feet deep.

In 1884 the entire field was subdivided into eleven plats of equal size, thirty-three by one hundred and seventy-five feet, with five feet of space between them. Every alternate plat has received from that date annually the same kind and the same amount of fertilizer, — six hundred pounds of ground bones and two hundred pounds of muriate of potash per acre. Since 1885 all crops on that field have been raised in rows; this system of cultivation became a necessity in the case of grasses, clovers, etc., to secure a clean crop for observation. The rows, in the case of corn and leguminous plants, were three feet and three inches apart; and, in the case of grasses, two feet. The space between the different plats has received, thus far, no manurial substance of any description, and is kept clean from vegetation by a proper use of the cultivator. Plats 11, 13, 15, 17, 19 and 21 were fertilized annually; plats 12, 14, 16, 18 and 20 have received no fertilizer until the season of 1889.

The details of the work carried on upon Field B are from year to year recorded in the annual report of the station. As the chemical analyses of the crops raised require considerable time, on account of other contemporary pressing engagements in the laboratory, they are usually published in bulletins, and the reports of the succeeding year.

The subsequent tabular statement of crops raised upon the different plats of Field B since 1886 may assist in a desirable understanding of its late history, and its condition at the beginning of the season of 1890.

| PLATS. | 1887. | 1888. | 1889. | 1890. |
|---|---|---|---|---|
| Plat 11 (fertilized), | Corn, | Kentucky blue-grass (*Poa pratensis*), | Kentucky blue-grass, | Kentucky blue-grass, sown Sept. 24, 1889. |
| Plat 12 (unfertilized), | Corn, | Kentucky blue-grass, | Kentucky blue-grass, | Kentucky blue-grass, sown Sept. 24, 1889. |
| Plat 13 (fertilized), | Italian rye-grass (*Lolium Italicum*), English rye-grass (*Lolium perenne*), | Italian rye-grass, English rye-grass, | Red-cob ensilage corn, | Red top, sown Sept. 24, 1889. |
| Plat 14 (unfertilized), | Italian rye-grass, English rye-grass, | Italian rye-grass, English rye-grass, | Red-cob ensilage corn, | Red top, sown Sept. 24, 1889. |
| Plat 15 (fertilized), | Five varieties Southern cow-pea, | Soja bean (*Soja hispida*), | Bokhara clover (*Melilotus alba*), Sainfoin (*Onobrychis sativa*), | Bokhara clover, sown May 8, 1889. Sainfoin, sown May 8, 1889. |
| Plat 16 (unfertilized), | Five varieties Southern cow-pea, | Soja bean, | Bokhara clover, Samfoin, | Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889. |
| Plat 17 (fertilized), | Meadow fescue (*Festuca pratensis*), | Meadow fescue, | Meadow fescue, | Meadow fescue, sown September, 1887. |
| Plat 18 (unfertilized), | Alsike clover (*Trifolium hybridum*), Medium red clover (*Trifolium pratense*), | Alsike clover, Medium red clover, | Red-cob ensilage corn, | Meadow fescue, sown September, 1889. |
| Plat 19 (fertilized), | Alsike clover, Medium red clover, | Alsike clover, Medium red clover, | Alsike clover, Medium red clover, | Herds grass, sown September, 1889. |
| Plat 20 (unfertilized), | Mammoth red clover (*Trifolium medium*), Alfalfa or lucerne (*Medicago sativa*), | Mammoth red clover, Alfalfa, | Red-cob ensilage corn, | Red top and herds grass, mixed, sown September, 1889. |
| Plat 21 (fertilized), | Mammoth red clover, Alfalfa, | Mammoth red clover, Alfalfa, | Corn (variety, Clark), | Meadow fescue and herds grass, mixed, sown September, 1889. |

The fertilizer annually applied since 1889 to all the plats alike consisted in each case of eighty pounds of steamed ground bones and of twenty-seven pounds of muriate of potash, or six hundred pounds of bones and two hundred pounds of muriate of potash per acre.

*1890.* — A grass mixture was sown broadcast on plats 20 and 21. The remaining plats were sown in drills two feet apart, sixteen rows in each plat. The crops seeded in rows were cultivated two or three times, and cleaned with the hoe during the growing season to remove the weeds and to clear the crops from admixtures.

The majority of the plats appeared well at the beginning of the season. The seeds proved, however, subsequently, in several instances, a bad investment for our purposes, where distinct varieties and not mixtures of grass seeds were needed.

Plats 11, 12, Kentucky blue-grass, sown Sept. 24, 1889. The growth looked well at the opening of spring, 1890. The cultivator and hoe were applied in the beginning of the season, and again in June, to remove the weeds. The crop was cut for the first time September 19; it did not head out during the season. The hay weighed two hundred pounds on Plat 11, and two hundred and sixty pounds on Plat 12.

Plats 13, 14, red top (*Agrostis vulgaris*), sown Sept. 24, 1889. The seed proved not well adapted to our purpose. It contained a considerable amount of seeds of herds grass. The crop was cut on both plats July 10, and yielded seven hundred and ten pounds of hay in all. The sod was subsequently ploughed under, and cut up by means of a wheel harrow. The soil prepared later on was reseeded Sept. 24, 1890.

Plat 15, Bokhara clover (*Melilotus alba*) and esparsette or sainfoin (*Onobrychis sativa*). Both were sown May 8, 1889. The Bokhara clover yielded, September 9, two hundred and three pounds of hay; the sainfoin did not head out in the first year, — it reached about five inches in height. Both crops looked fairly well in the spring of 1890, yet showed here and there the effects of winter-killing. They were cut for hay; Bokhara clover yielded two cuts, sainfoin but one. Bokhara clover was cut June 24, yielding two

hundred and five pounds of hay, and again September 22, yielding seventy-five pounds. Sainfoin was cut June 24, and yielded one hundred and twenty-five pounds of hay; the aftergrowth would have furnished a rich pasture for cows.

Plat 16, Rhode Island bent (*Agrostis alba*), sown Sept. 25, 1889. The growth looked promising at the opening of the season, yet turned out later on to contain a considerable admixture of herds grass. The crop was cut July 9, and it yielded three hundred and twenty pounds of hay. The sod was turned under July 15, and cut up with a wheel harrow. The plat, after thorough preparation, was reseeded in September, 1890.

Plat 17, meadow fescue (*Festuca pratensis*), sown September, 1887. Started out vigorously with an unbroken sod; began blooming during the first week of June, and was nearly through blooming June 20. It was cut June 24, and measured from three to three and a half feet in height. Two crops were secured, June 24 and September 22. The first cut yielded seven hundred and thirty pounds of hay, and the second cut two hundred and fifty-five pounds.

Plat 18, meadow fescue, sown Sept. 22, 1889. The seed proved, to a serious degree, to be a mixture of grass seeds. The crop was cut July 9, and yielded three hundred and ninety pounds of hay. The sod was ploughed under July 15, cut up with a wheel harrow, and subsequently, after due preparation, reseeded Sept. 24, 1890.

Plat 19, herds grass (*Phleum pratense*), sown Sept. 25, 1889. Looked well in the spring; began to blossom June 30; was cut July 9. It yielded five hundred and fifty pounds of hay. The second crop was cut September 22, and yielded two hundred and five pounds of hay.

Plat 20, a mixture of herds grass, two and one-half pounds (= 2 quarts), and red top, two and one-half pounds (= 6 quarts), which were sown Sept. 24, 1889. The crop looked fair in the spring; was cut July 9; it yielded four hundred and thirty pounds of hay, first cut. The grass suffered somewhat from a brown fungus. The sod was for this reason ploughed under, and the soil prepared, in the

same manner as previously described in case of other plats, for a reseeding during the succeeding September.

Plat 21, a mixture of meadow fescue, two and one-half pounds (= 4 quarts), and herds grass, two and one-half pounds (= 2 quarts), was sown Sept. 25, 1889. The plat looked well in the spring; it proved in part a failure, on account of the mixed character of the seeds, and of the appearance of a brown fungus upon the plants. The first cut yielded three hundred and ninety pounds of hay. The sod was ploughed under soon after harvesting the hay, and the land reseeded after a careful preparation of the soil, Sept. 25, 1890.

All plats reseeded during the late autumn have been fertilized in a like manner, with the same mixture which has been used for several years upon Field B; namely, six hundred pounds of ground steamed bones and two hundred pounds of muriate of potash per acre. Extra precaution has been taken to secure seeds fit for our purpose, which in this connection consists in comparing single varieties of grasses and other reputed fodder crops, regarding their nutritive character and their comparative economical value, when raised under otherwise corresponding circumstances upon farms in Massachusetts.

Some of the results of the analyses of crops raised upon Field B, during 1889 and 1890, as far as they are not yet published, will be found upon a few subsequent pages.

*Meadow Fescue.*

[In full bloom, June 14, 1889. (Field B.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.30 |
| Dry matter, | 94.70 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 8.50 |
| " cellulose, | 39.65 |
| " fat, | 1.97 |
| " protein (nitrogenous matter), | 7.85 |
| Non-nitrogenous extract matter, | 42.03 |
| | 100.00 |

*Fertilizing Constituents of Meadow Fescue.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.300 |
| Calcium oxide, | 0.616 |
| Magnesium oxide, | 0.269 |
| Ferric oxide, | 0.019 |
| Sodium oxide, | 0.603 |
| Potassium oxide, | 2.461 |
| Phosphoric acid, | 0.625 |
| Nitrogen, | 1.190 |
| Insoluble matter, | 0.151 |
| Ash, | 8.500 |
| Valuation per ton, | $6 89 |

*Kentucky Blue-grass.*

[Collected June 14, 1889; just past blooming. (Field B.)]

| | Per Cent. | |
|---|---|---|
| | Fertilized. | Unfertilized. |
| Moisture at 100° C., | 6.78 | 3.90 |
| Dry matter, | 93.22 | 96.10 |
| | 100.00 | 100.00 |
| *Analysis of Dry Matter.* | | |
| Crude ash, | 8.24 | 7.45 |
| " cellulose, | 36.84 | 32.21 |
| " fat, | 2.03 | 2.08 |
| " protein (nitrogenous matter), | 8.78 | 8.65 |
| Non-nitrogenous extract matter, | 44.11 | 49.61 |
| | 100.00 | 100.00 |

*Fertilizing Constituents of Kentucky Blue-grass.*

| | Per Cent. | |
|---|---|---|
| | Fertilized. | Unfertilized. |
| Moisture at 100° C., | 6.780 | 3.900 |
| Calcium oxide, | 0.366 | 0.429 |
| Ferric oxide, | 0.031 | 0.057 |
| Sodium oxide, | 0.067 | 0.181 |
| Potassium oxide, | 2.110 | 1.277 |
| Phosphoric acid, | 0.414 | 0.447 |
| Nitrogen, | 1.310 | 1.330 |
| Insoluble matter, | 3.203 | 2.522 |
| Valuation per ton, | $6 74 | $5 66 |

### *Alsike Clover.*

[Collected June 14, 1889; in full bloom. (Field B.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 9.96 |
| Dry matter, | 90.04 |
| | 100.00 |

### *Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 13.06 |
| " cellulose, | 26.11 |
| " fat, | 2.19 |
| " protein (nitrogenous matter), | 16.65 |
| Non-nitrogenous extract matter, | 41.99 |
| | 100.00 |

### *Fertilizing Constituents of Alsike Clover.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 9.960 |
| Calcium oxide, | 1.870 |
| Ferric oxide, | 0.104 |
| Sodium oxide, | 0.266 |
| Potassium oxide, | 3.320 |
| Phosphoric acid, | 0.495 |
| Nitrogen, | 2.399 |
| Insoluble matter, | 1.928 |
| Valuation per ton, | $11 57 |

### *Medium Clover.*

[Collected July 12, 1889; in full bloom. (Field B.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.10 |
| Dry matter, | 94.90 |
| | 100.00 |

### *Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 9.06 |
| " cellulose, | 30.76 |
| " fat, | 2.36 |
| " protein (nitrogenous matter), | 15.01 |
| Non-nitrogenous extract matter, | 42.81 |
| | 100.00 |

*Fertilizing Constituents of Medium Clover.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.100 |
| Calcium oxide, | 1.539 |
| Ferric oxide, | 0.137 |
| Sodium oxide, | 0.227 |
| Potassium oxide, | 2.370 |
| Phosphoric acid, | 0.457 |
| Nitrogen, | 2.279 |
| Insoluble matter, | 1.583 |
| Valuation per ton, | $10 35 |

*Sweet Clover (Melilotus alba).*

[Collected Oct. 3, 1889. (Field C.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 6.36 |
| Dry matter, | 93.64 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 6.90 |
| " cellulose, | 28.08 |
| " fat, | 1.85 |
| " protein (nitrogenous matter), | 11.81 |
| Non-nitrogenous extract matter, | 51.36 |
| | 100.00 |

*Fertilizing Constituents of Sweet Clover.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 6.360 |
| Calcium oxide, | 1.938 |
| Magnesium oxide, | 0.373 |
| Ferric oxide, | 0.025 |
| Sodium oxide, | 0.077 |
| Potassium oxide, | 1.673 |
| Phosphoric acid, | 0.436 |
| Nitrogen, | 1.770 |
| Insoluble matter, | 0.013 |
| Valuation per ton, | $7 96 |

*Sainfoin (Onobrychis sativa).*

[Past blooming; collected June 20, 1890.]

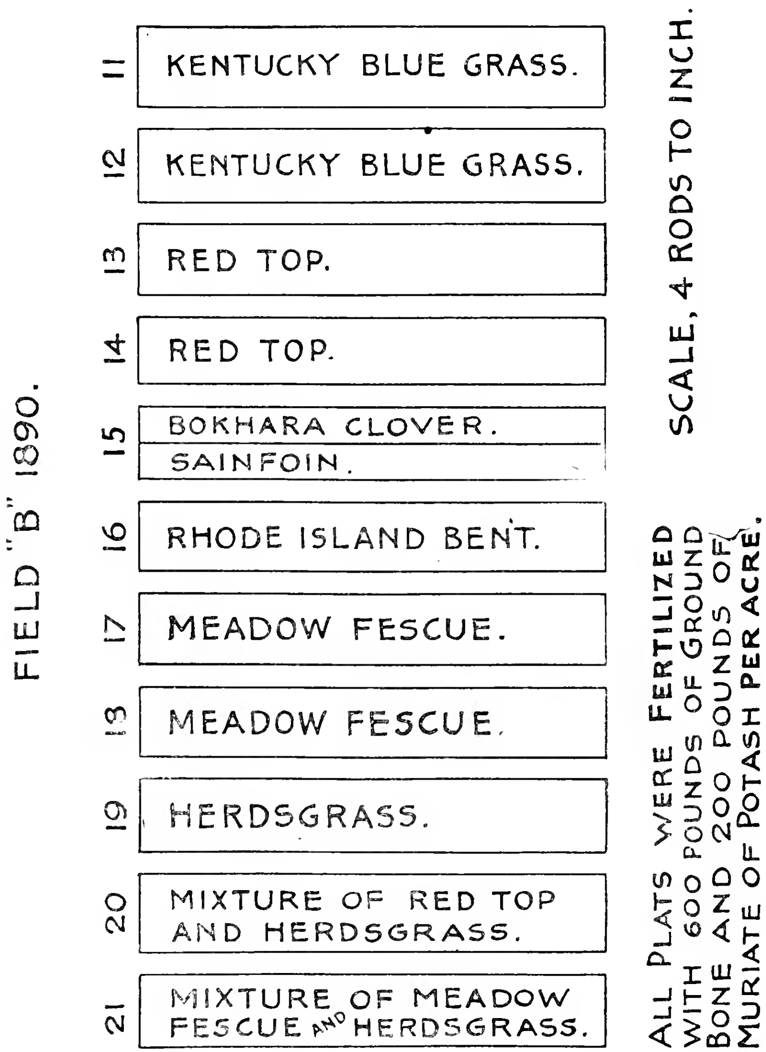
| | Per Cent. |
|---|---|
| Moisture at 100° C., | 12.17 |
| Dry matter, | 87.83 |
| | 100.00 |

*Analysis of Dry Matter.*

| | Per Cent. |
|---|---|
| Crude ash, | 8.54 |
| " cellulose, | 26.95 |
| " fat, | 4.49 |
| " protein (nitrogenous matter), | 17.70 |
| Non-nitrogenous extract matter, | 42.27 |
| | 100.00 |

*Fertilizing Constituents of Sainfoin.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 12.17 |
| Calcium oxide, | 1.16 |
| Magnesium oxide, | 0.43 |
| Ferric oxide, | 0.04 |
| Sodium oxide, | 0.54 |
| Potassium oxide, | 2.02 |
| Phosphoric acid, | 0.76 |
| Nitrogen, | 2.63 |
| Insoluble matter, | 0.47 |
| Valuation per ton, | $11 57 |


FIELD "B" 1890.
11 KENTUCKY BLUE GRASS.
12 KENTUCKY BLUE GRASS.
13 RED TOP.
14 RED TOP.
15 BOKHARA CLOVER.
SAINFOIN.
16 RHODE ISLAND BENT.
17 MEADOW FESCUE.
13 MEADOW FESCUE.
19 HERDSGRASS.
20 MIXTURE OF RED TOP AND HERDSGRASS.
21 MIXTURE OF MEADOW FESCUE AND HERDSGRASS.
SCALE, 4 RODS TO INCH.
ALL PLATS WERE FERTILIZED WITH 600 POUNDS OF GROUND BONE AND 200 POUNDS OF MURIATE OF POTASH PER ACRE.

## VIII. Experiments with Field and Garden Crops. (Fields C and D.)

### *Field C.*

This field comprises an area 328 feet long and 183 feet wide; it is subdivided into two parts, running from east to west; they are separated by a passage-way three feet wide.

The system of manuring and of cultivating is the same on both divisions. They are annually manured with a mixture consisting of fine-ground steamed bone, six hundred pounds, and muriate of potash, two hundred pounds, per acre. The field is usually ploughed in the fall and early in spring, with the exception of small areas occupied by perennial plants. The fertilizer is applied broadcast early in spring, and subsequently slightly harrowed in.

The crops are in the majority of cases planted in drills, to secure chances for clean cultivation. The land has served, for several years past, for the same purposes; namely, to ascertain the particular degree of adaptation of reputed farm crops to our climate and our soil. In some instances sufficient quantities of one or the other were raised to furnish fodder for summer and winter feeding experiments. In the majority of cases, however, the main object of the planting was to secure suitable material for analysis, to determine their relative economical value either for general farm purposes or for special industrial purposes. The variety of crops already tested in this connection is quite numerous; for details regarding previous years, we have to refer to our preceding annual reports. Some analyses of crops raised on fields C and D during the year 1889 are published, for the first time, within a few subsequent pages.

*Lotus villosus.*
Sulla (*Hedysarum coronaria*).
Teosinte.
Japanese buckwheat.
Small pea (*Lathyrus sativus*).
Carrot (*Daucus carota*).

*1890.* — The entire field, both divisions, was ploughed during the autumn of 1889, and again May 1, 1890. The

fertilizer, six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash, per acre, was sown soon after the ploughing, slightly harrowed under, and the various seeds subsequently planted as stated below.

The entire south side of Field C was planted with barley, in rows two feet apart. The north side was occupied by a series of crops in the following order, beginning at the east end of the field: —

5 rows English rye grass, rows two feet apart.
3 rows early Southern white corn, rows three feet three inches apart.
2 rows early Southern cow-pea, rows three feet three inches apart.
4 rows horse bean, rows three feet three inches apart.
4 rows white soja bean, rows three feet three inches apart.
4 rows black soja bean, rows three feet three inches apart.
2 rows bush peas, rows three feet three inches apart.
4 rows Scotch tares, rows three feet three inches apart.
4 rows common vetch, rows three feet three inches apart.
4 rows white lupine, rows three feet three inches apart.
4 rows serradella, rows three feet three inches apart.
4 rows Bokhara clover, rows three feet three inches apart.
4 rows sainfoin, rows three feet three inches apart.
4 rows English rye grass, rows two feet apart.
1 row sulla.
1 row festuca No. 1 (Connecticut).
2 rows pyrethrum, rows two feet apart.
3 rows lotus villosus, rows three feet three inches apart.
15 rows Florimond Desprez's richest sugar beet, rows two feet apart.
15 rows Bulteau Desprez's richest sugar beet, rows two feet apart.
15 rows Dippe's Kleinwanzleben sugar beet, rows two feet apart.
15 rows Dippe's Vilmorin sugar beet, rows two feet apart.
16 rows Simon Le Grand's white improved sugar beet, rows two feet apart.

The entire field was kept clean from weeds by a timely use of a one-horse cultivator and the hoe.

*Barley.* — The area occupied by barley was 30,504 square feet. It required thirty-four pounds of seed, or forty-eight to fifty pounds per acre. The seed was planted with a brush seeding machine, without plate, May 3. The young plants began to come up May 6. They were cultivated June 3, and headed out June 25. The heads remained free from smut, but the leaves showed many brown spots, due to fungous growth.

The crop reached a height of twenty-five inches, and turned yellow July 25. It was cut July 31, and put in the

barn August 3. When threshed, September 15, it yielded 430 pounds of grain and 1,795 pounds of straw and chaff, which is equal to 610 pounds of grain and 2,531 pounds of straw and chaff, per acre.

The ground which was used for the production of the barley was ploughed August 2. After being fertilized with 225 pounds of fine-ground steamed bone (one-half of our customary annual dressing of bone), it was planted with turnips and ruta-bagas, in rows two feet apart. The crop was thinned out in the rows and twice cleaned with the cultivator. It was harvested November 5. The turnips came to a good average size, and the ruta-bagas only to a small medium size. Both were of excellent quality for family use, selling in our local market at fifty cents per bushel. The entire crop amounted to 7,715 pounds.

*English Rye Grass* (*Lolium perenne*). — This was sown May 30. The young plants appeared above ground June 5. They made a good growth, yet did not head out during the season. The grass was cut at the customary time for second cut of upland meadow grasses, and the sod left over winter, to notice the effect of that season on the crop. In one of our preceding experiments the plants were winter-killed. The main object of this trial was to secure additional facts regarding that point.

*Early Southern White Corn.* — The corn was planted May 23. The young plants were noticed above ground June 2. It made a very heavy rank growth, yet proved much too late for maturing in our locality.

*Horse Bean* (*Vicia faba*). — This was planted May 23, appeared above ground June 2; reached a height of twenty-five inches before it began to bloom, July 9. It suffered temporarily somewhat from drought; recovered, however, subsequently. The roots of the plants, when thirty-one inches high, July 18, showed a remarkably large number of tubercles. The plant keeps on blooming until a killing frost destroys it. This plant has served us well on former occasions for green manuring.

*Soja Bean* (*Soja hispida*). — Two varieties, white and black, were planted May 23; they came above ground June 2. The white variety began to bloom August 9, and

the black variety but one day later. The foliage of the white variety was darker green than that of the black, throughout the season. Both stood the drought well. The roots had apparently no tubercles. The white variety matured sooner than the black one. The soja bean promises to be a valuable addition to the leguminous fodder crops in New England. Two acres have been planted with soja beans during the past season, on the grounds of the station. The growth of one acre has served, in its semi-matured state, as green fodder during the autumn (see summer feeding experiment on previous pages of this report) for milch cows; and that of the other has been put in a silo as an admixture to corn ensilage (see statements on silos).

*Scotch Tares* (a coarse variety of vetch). — The seed was kindly furnished by Mr. James Cheesman of Southborough, Mass., who had imported some for his own experiments. It was planted May 23, was above ground June 3; had reached a height of twelve inches, July 18, before it began to spread. The plants began blooming July 23. The crop was cut for hay August 2. One acre has been planted on another part of our farm during the past season, to serve as winter fodder for cattle.

*Common Vetch* (*Vicia sativa*). — The seed was planted May 23; the young plants were above ground June 1. They began to bloom July 12, when twelve inches high. The plants formed subsequently a rank, thick growth. This variety of vetch has been raised for several years very successfully on our farm, either by itself or as an admixture of oats and barley, for green fodder, toward the close of July, when they begin to bloom. It is one of the earliest annual leguminous fodder crops at our disposal, and has rendered us for several years past excellent services as green fodder for milch cows. It can be used green or in its dried state, as circumstances advise. An admixture of oats and barley renders the crop very acceptable to dairy stock.

*White Lupine* (*Lupinus alba*). — This was planted May 23; appeared above ground June 1; began to blossom July 7, and reached a height of twenty-five inches. The crop became infested with insects, and proved no success during the past season. The best services we have thus far

received from the various varieties of lupines, white, yellow and blue, consists in their fitness for green manuring. The plant grows rapidly, is succulent, and comparatively rich in nitrogenous matter. The crop can be ploughed under with profit in the beginning of August. The disintegration of the plant has usually sufficiently advanced at the beginning of September to render the soil fit for thorough mechanical preparation, preparatory to the seeding down of grasses or of winter crops.

*Serradella* (*Ornithopus sativus*). — The successful cultivation of this valuable fodder crop depends, in our part of the country, apparently in exceptional degrees, on the character of the soil and the season. A deep, sandy loam, and a fair average temperature of the summer season, tend to secure success. Under favorable circumstances we have obtained from ten to twelve tons of green fodder, with an average percentage of dry matter of from nineteen to twenty per cent. Fed green from the beginning to the end of September, 1887 and 1889, at the rate of seventy to eighty pounds per day, with one-quarter of the ordinary English hay ration (five pounds), the result has been in an exceptional degree satisfactory. Serradella has surpassed in our case the effect of Southern cow-pea and vetch and oats, as a green fodder for dairy cows. It competes fairly with soja bean in that connection. Cold and wet summer seasons, and cold, springy lands, each in their own way interfere seriously with a timely vigorous growth, and thus with the production of a remunerative crop. Our trial with this crop during the late season has been a failure, on account of the springy character of the land selected for its cultivation.

*Bokhara Clover* (*Melilotus alba*) and *Sainfoin* (*Onobrychis sativa*, — *Esparsette*) are already described in previous pages (Field B). The bulky, heavy growth of the Bokhara clover, and its pleasant odor, resembling somewhat that of the sweet vernal grass (*Anthoxanthum odoratum*), render it desirable to institute experiments for the purpose of ascertaining its fitness for ensilage. Its stems are succulent at the time when the plant has reached its full height (four to four and one-half feet). Our locality is evidently too cold to render the cultivation of sainfoin advisable.

*Sulla* (*Hedysarum coronaria*) and *Lotus villosus* have for several years shown a healthy and vigorous growth on our grounds; they stand our average winter very well. Both deserve a serious trial for stocking pastures with a nutritious growth. They shade the ground more efficiently in such localities than any of our coarser clover varieties. Some subsequent statements of their composition illustrate their high feeding value.

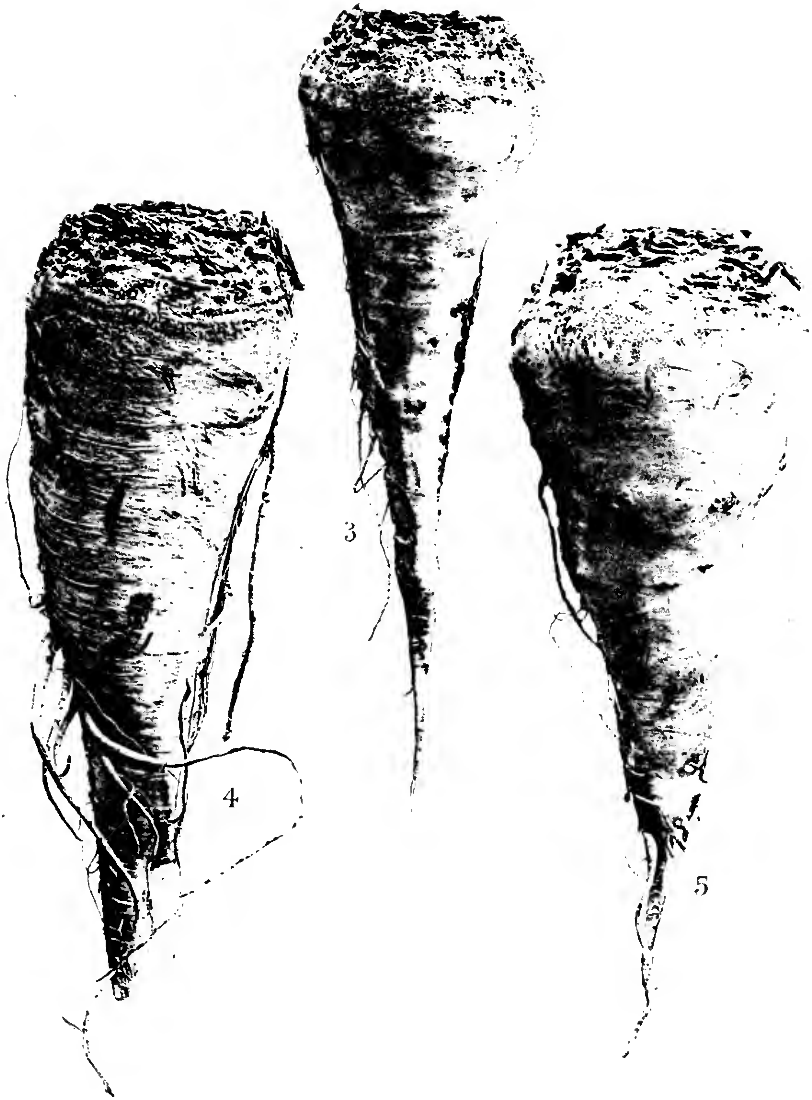
*Sugar Beets.* — The seeds were sent on by the United States Department of Agriculture, for trial, accompanied by the directions to return in due time average specimens of roots of the five varieties for examination at the laboratory of the department in Washington.

They were planted in rows two feet apart, in a well-prepared soil, May 5, each variety properly marked. The young plants came up May 17: they suffered subsequently somewhat from leaf-miners, but soon recovered without any apparent serious consequences. The crop was cleaned twice with the cultivator, and the plants thinned out to six inches apart July 8. They suffered during the latter part of the summer here and there from brown spots on the leaves. The pulling of the roots began October 2, with the following.

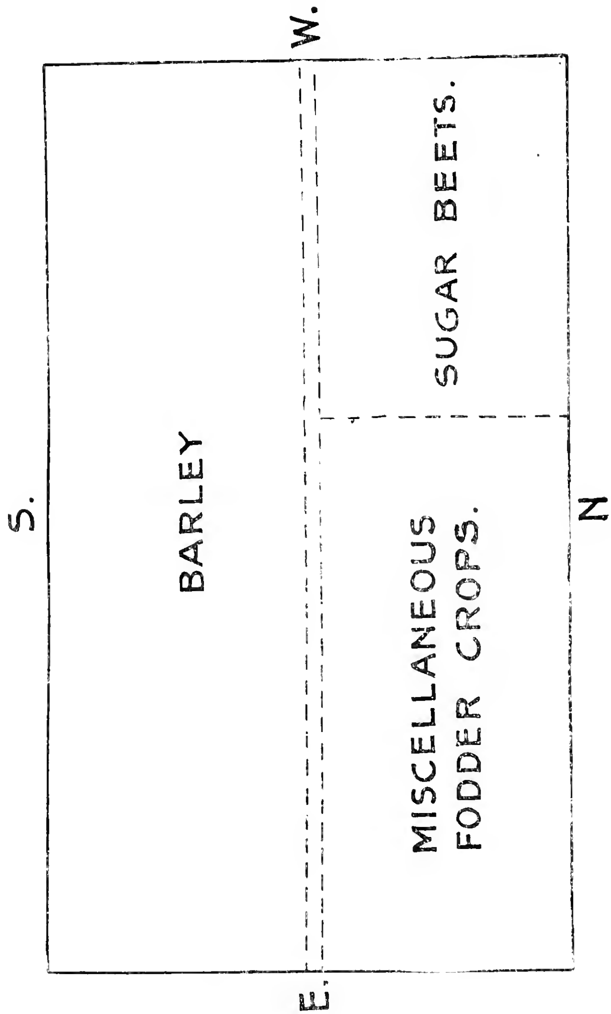
| | | Pounds. |
|---|---|---|
| I. | Florimond Desprez's richest, | 760 |
| II. | Bulteau Desprez's richest, | 760 |
| III. | Dippe's Kleinwanzleben, | 705 |
| IV. | Dippe's Vilmorin, | 680 |
| V. | Simon Le Grand's white improved, | 865 |
| | Total, | 3,770 |

1

2


3
4
5

FIELD "C" 1890.




SCALE. 4 RODS TO INCH.

The majority of the roots were of a smaller size than usual. The quality of some varieties proved to be fair; others have but little value for the production of sugar, as will be seen from the analyses farther on.

The importance of a reliable seed, a good preparation of a deep soil, a proper system of fertilization, a close planting, and a subsequent careful mode of cultivation for the successful production of sugar beet roots fit for an economical manufacture of sugar, has been abundantly illustrated by the writer, by a series of field experiments upon the college farm, as far back as 1873–1876. (See Massachusetts Agricultural College reports for those years.)

*Field D.*

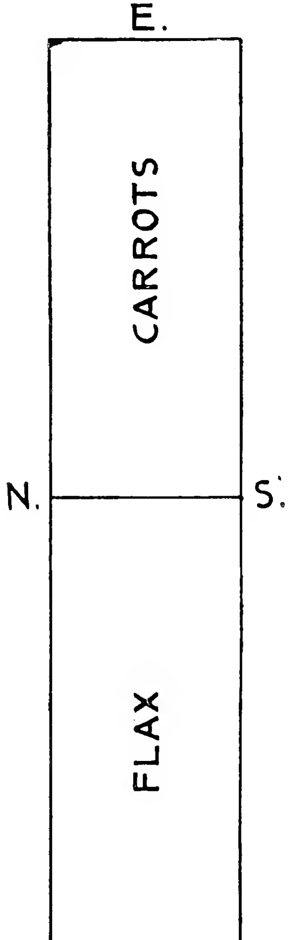
It comprises an area 328 feet long and 70 feet wide, equal to 22,960 square feet, running from east to west, parallel with Field C, with a grass road twelve feet in width between them. Mode of manuring and preparation of the soil previous to seeding corresponds with that described in connection with Field C. The eastern half of the land was planted with carrots, the western with flax.

*Flax* (*Linum usitatissimum*). — About one-fourth of an acre was sown with flax-seed May 23. Forty-four pounds of seed were used for that purpose. The seed was applied broadcast in two directions, to secure a close stand of the crop. The young plants showed themselves above ground May 29. The crop was weeded by hand June 30. It began to bloom July 2, and reached a height of two feet August 1. As soon as the color of the plants changed decidedly into a greenish-yellow tint, they were pulled, to secure a valuable straw. The seeds were but partly matured. The entire crop when harvested weighed 1,510 pounds. The seed heads were taken off by means of an iron comb, and the straw set up out of doors to dry. The dried straw weighed 670 pounds, August 22. This weight corresponds to 2,570 pounds per acre.

The entire crop was sent to a New York company, according to a previous arrangement, to be converted, by a new process of bleaching, etc., into linen goods, to test its quality for that purpose.

*Carrots* (*Daucus carota*), *Danvers Yellow.* — The seed was planted by means of a brush-seeding apparatus, using the plate third in size from the smallest, in rows two feet apart, to allow the use of a one-horse cultivator for cleaning, etc., May 9. The crop was subsequently thinned out July 16, and weeded twice by hand. The roots were pulled October 15. They were left for several days in the field in piles, covered with the tops of the roots, before hauling them in. The yield amounted to somewhat over four tons, equal to from sixteen to seventeen tons of carrots per acre.

FIELD "D" 1890.




SCALE, 4 RODS To 1 INCH.

### *Sugar Beets.*

[From station grounds.]

1. Florimond Desprez's richest sugar beet.
2. Bulteau Desprez's richest sugar beet.
3. Dippe's Kleinwanzleben.
4. Dippe's Vilmorin.
5. Simon Le Grand's white improved.

| | Date of Test. | Sugar by Polariscope. | Sugar by Fehling's Test. | Degrees Brix. | Specific Gravity of Juice. | Moisture at 100°C. |
|---|---|---|---|---|---|---|
| | | Per Cent. | Per Cent. | | | |
| 1, Sugar beet, | October 29, | 11.92 | 11.95 | – | – | 82.13 |
| 2, Sugar beet, | October 30, | 11.66 | 11.55 | – | – | 83.19 |
| 3, Sugar beet, | October 29, | 12.25 | 12.09 | – | – | 81.63 |
| 4, Sugar beet, | October 30, | 11.76 | 11.69 | – | – | 83.15 |
| 5, Sugar beet, | October 31, | 9.74 | 9.52 | – | – | 85.04 |
| | | Sugar in Juice. | Sugar in Beets. | | | |
| | | Per Cent. | Per Cent. | Juice. | Juice. | |
| 1, Sugar beet, | November 10, | 13.08 | – | 16.50 | 1.06783 | – |
| 2, Sugar beet, | November 11, | 13.16 | 12.42 | 17.04 | 1.07002 | – |
| 3, Sugar beet, | November 10, | 14.30 | 13.10 | 17.30 | 1.07133 | – |
| 4, Sugar beet, | November 10, | 12.75 | 12.26 | 15.70 | 1.06436 | – |
| 5, Sugar beet, | November 11, | 13.42 | 12.67 | 16.60 | 1.06827 | – |

### *Lotus Villosus.*

[Collected June 21, 1889; in full bloom. (Field D.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 10.68 |
| Dry matter, | 89.32 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 8.23 |
| " cellulose, | 24.48 |
| " fat, | 3.00 |
| " protein (nitrogenous matter), | 13.49 |
| Non-nitrogenous extract matter, | 50.80 |
| | 100.00 |

*Fertilizing Constituents of Lotus Villosus.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 10.680 |
| Calcium oxide, | 1.579 |
| Magnesium oxide, | 0.336 |
| Ferric oxide, | 0.076 |

*Fertilizing Constituents of Lotus Villosus* — Concluded.

| | Per Cent. |
|---|---|
| Sodium oxide, | 0.365 |
| Potassium oxide, | 2.064 |
| Phosphoric acid, | 0.688 |
| Nitrogen, | 1.930 |
| Insoluble matter, | 0.888 |
| Valuation per ton, | $9 13 |

*Sulla (Hedysarum coronaria).*

[Collected June 11, 1889; in full bloom. (Field D.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 8.32 |
| Dry matter, | 91.68 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 9.87 |
| " cellulose, | 28.95 |
| " fat, | 2.39 |
| " protein (nitrogenous matter), | 16.90 |
| Non-nitrogenous extract matter, | 41.89 |
| | 100.00 |

*Fertilizing Constituents of Sulla.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 8.320 |
| Calcium oxide, | 2.203 |
| Magnesium oxide, | 0.321 |
| Ferric oxide, | 0.081 |
| Sodium oxide, | 0.083 |
| Potassium oxide, | 2.314 |
| Phosphoric acid, | 0.482 |
| Nitrogen, | 2.479 |
| Insoluble matter, | 0.240 |
| Valuation per ton, | $10 98 |

*Teosinte.*

[Station, 1889. (Field D.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 6.06 |
| Dry matter, | 93.94 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 6.95 |
| " cellulose, | 28.88 |
| " fat, | 1.28 |
| " protein (nitrogenous matter), | 9.71 |
| Non-nitrogenous extract matter, | 53.18 |
| | 100.00 |

*Fertilizing Constituents of Teosinte.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 6.060 |
| Calcium oxide, | 1.597 |
| Magnesium oxide, | 0.458 |
| Ferric oxide, | 0.021 |
| Sodium oxide, | 0.109 |
| Potassium oxide, | 3.696 |
| Phosphoric acid, | 0.546 |
| Nitrogen, | 1.460 |
| Insoluble matter, | 0.315 |
| Valuation per ton, | $8 76 |

*Japanese Buckwheat.*

[Collected June 28, 1889; little past blooming. (Field D.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.72 |
| Dry matter, | 94.28 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 12.36 |
| " cellulose, | 36.02 |
| " fat, | 2.22 |
| " protein (nitrogenous matter), | 10.80 |
| Non-nitrogenous extract matter, | 38.60 |
| | 100.00 |

*Fertilizing Constituents of Japanese Buckwheat.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.720 |
| Calcium oxide, | 3.418 |
| Magnesium oxide, | 0.421 |
| Ferric oxide, | 0.148 |
| Sodium oxide, | 0.349 |
| Potassium oxide, | 3.320 |
| Phosphoric acid, | 0.850 |
| Nitrogen, | 1.629 |
| Insoluble matter, | 0.378 |
| Valuation per ton, | $9 38 |

*Small Pea (Lathyrus sativus).*

[Collected Sept. 3, 1889. (Field D.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.80 |
| Dry matter, | 94.20 |
| | 100.00 |

*Analysis of Dry Matter*

| | Per Cent. |
|---|---|
| Crude ash, | 6.30 |
| " cellulose, | 32.88 |
| " fat, | 1.49 |
| " protein (nitrogenous matter), | 16.57 |
| Non-nitrogenous extract matter, | 42.76 |
| | 100.00 |

*Fertilizing Constituents of Small Pea.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 5.800 |
| Calcium oxide, | 1.373 |
| Magnesium oxide, | 0.276 |
| Ferric oxide, | 0.138 |
| Sodium oxide, | 0.469 |
| Potassium oxide, | 1.990 |
| Phosphoric acid, | 0.592 |
| Nitrogen, | 2.497 |
| Insoluble matter, | 1.081 |
| Valuation per ton, | $10.89 |

*Scotch Tares.*

[Whole plant, at end of blooming; station, 1890. (Field C.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 15.80 |
| Dry matter, | 84.20 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 13.76 |
| " cellulose, | 30.89 |
| " fat, | 1.89 |
| " protein (nitrogenous matter), | 22.00 |
| Non-nitrogenous extract matter, | 31.46 |
| | 100.00 |

*Fertilizing Constituents of Scotch Tares.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 15.800 |
| Calcium oxide, | 1.698 |
| Magnesium oxide, | 0.354 |
| Ferric oxide, | 0.469 |
| Sodium oxide, | 0.238 |
| Potassium oxide, | 3.004 |
| Phosphoric acid, | 0.815 |
| Nitrogen, | 2.964 |
| Insoluble matter, | 4.062 |
| Valuation per ton, | $13.61 |

### *Carrots.*

[Station, 1889.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 89.57 |
| Dry matter, | 10.43 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 8.76 |
| " cellulose, | 8.16 |
| " fat, | 1.86 |
| " protein (nitrogenous matter), | 9.18 |
| Non-nitrogenous extract matter, | 72.13 |
| | 100.00 |

*Fertilizing Constituents of Carrots.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 89.570 |
| Calcium oxide, | 0.064 |
| Magnesium oxide, | 0.025 |
| Ferric oxide, | 0.007 |
| Sodium oxide, | 0.013 |
| Potassium oxide, | 0.472 |
| Phosphoric acid, | 0.086 |
| Nitrogen, | 0.153 |
| Insoluble matter, | 0.027 |
| Valuation per ton, | $1 02 |

### *Carrot Tops (1889).*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 9.760 |
| Calcium oxide, | 2.089 |
| Magnesium oxide, | 0.667 |
| Ferric oxide, | 0.118 |
| Sodium oxide, | 4.028 |
| Potassium oxide, | 4.883 |
| Phosphoric acid, | 0.612 |
| Nitrogen, | 3.130 |
| Insoluble matter, | 0.098 |
| Valuation per ton, | $15 52 |

### *Parsnips.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 80.34 |
| Dry matter, | 19.66 |
| | 100.00 |

*Analysis of Dry Matter.*

| | Per Cent. |
|---|---|
| Crude ash, | 7.43 |
| " cellulose, | 7.67 |
| " fat, | 3.37 |
| " protein (nitrogenous matter), | 6.88 |
| Non-nitrogenous extract matter, | 74.65 |
| | 100.00 |

*Fertilizing Constituents of Parsnips.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 80.340 |
| Calcium oxide, | 0.088 |
| Magnesium oxide, | 0.045 |
| Ferric oxide, | 0.005 |
| Sodium oxide, | 0.006 |
| Potassium oxide, | 0.617 |
| Phosphoric acid, | 0.187 |
| Nitrogen, | 0.217 |
| Insoluble matter, | 0.019 |
| Valuation per ton, | $1 50 |

*Barley Straw.*

[Station, 1890. (Field C.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.44 |
| Dry matter, | 88.56 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 5.30 |
| " cellulose, | 33.85 |
| " fat, | 3.38 |
| " protein (nitrogenous matter), | 9.24 |
| Non-nitrogenous extract matter, | 48.23 |
| | 100.00 |

*Fertilizing Constituents of Barley Straw.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.44 |
| Calcium oxide, | 0.57 |
| Magnesium oxide, | 0.18 |
| Sodium oxide, | 0.18 |
| Potassium oxide, | 2.09 |
| Phosphoric acid, | 0.30 |
| Nitrogen, | 1.31 |
| Insoluble matter, | 0.24 |
| Valuation per ton, | $6 59 |

### *Bokhara Clover.*

[Collected June 26, 1890. (Field D.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 8.50 |
| Dry matter, | 91.50 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 8.41 |
| " cellulose, | 33.05 |
| " fat, | 4.79 |
| " protein (nitrogenous matter), | 14.92 |
| Non-nitrogenous extract matter, | 38.82 |
| | 100.00 |

*Fertilizing Constituents of Bokhara Clover.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 8.50 |
| Calcium oxide, | 1.63 |
| Magnesium oxide, | 0.32 |
| Ferric oxide, | 0.02 |
| Sodium oxide, | 0.15 |
| Potassium oxide, | 1.99 |
| Phosphoric acid, | 0.68 |
| Nitrogen, | 2.18 |
| Insoluble matter, | 0.10 |
| Valuation per ton, | $9 92 |

### *Soja Bean.*

[Collected Aug. 27, 1890, station; blooming. (Field D.)]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 74.17 |
| Dry matter, | 25.83 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 11.05 |
| " cellulose, | 24.73 |
| " fat, | 7.22 |
| " protein (nitrogenous matter), | 13.64 |
| Non-nitrogenous extract matter, | 43.36 |
| | 100.00 |

### *Turnips.*

[Experiment Station, 1890.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 91.78 |
| Dry matter, | 8.22 |
| | 100.00 |

*Analysis of Dry Matter.*

| | Per Cent |
|---|---|
| Crude ash, | 9.54 |
| " cellulose, | 12.61 |
| " fat, | 2.05 |
| " protein (nitrogenous matter), | 9.89 |
| Non-nitrogenous extract matter, | 65.91 |
| | 100.00 |
| Albuminoid nitrogen (in dry matter), | 1.09 |
| Total nitrogen, | 1.58 |

*Fertilizing Constituents of Turnips.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 91.780 |
| Calcium oxide, | 0.061 |
| Magnesium oxide, | 0.020 |
| Sodium oxide, | 0.022 |
| Potassium oxide, | 0.358 |
| Phosphoric acid, | 0.092 |
| Nitrogen, | 0.134 |
| Insoluble matter, | 0.038 |
| Valuation per ton, | $0 87 |

## IX. Experiments to study the Economy of using Different Commercial Sources of Phosphoric Acid for Manurial Purposes in Farm Practice. (Field F.)

The field selected for this purpose was 300 feet long and 137 feet wide, running on a level from east to west. Previous to 1887 it was used as a meadow, which was well worn out at that time, yielding but a scanty crop of English hay. During the autumn of 1887 the sod was turned under, and left in that state over winter. It was decided to prepare the field for special experiments with phosphoric acid by a systematic exhaustion of its inherent resources of plant food. For this reason no manurial matter of any description was applied during the years 1887, 1888 and 1889.

The soil, a fair sandy loam, was carefully prepared every year by ploughing during the fall and in the spring, to improve its mechanical condition to the full extent of existing circumstances. During the same period a crop was raised every year. These crops were selected, as far as practicable, with a view to exhaust the supply of phosphoric acid in particular. Corn, Hungarian grass and leguminous crops (cow-pea, vetch and serradella), followed each other in the order stated.

*1890.* — The land had been ploughed during the preceding fall, and again April 19, 1890. The field was subdivided subsequently into five plats of definite size, each running from east to west. These plats were separated from each other by a space eight feet wide.

The plats and spaces between them were ploughed and harrowed alike. The plats were fertilized at stated times; the spaces which separated them received at no time any kind of manurial matter.

The manurial material applied to each of these five plats contained, in every instance, the same form and the same quantity of potassium and of nitrogen, while the phosphoric acid was furnished in each case in the form of a different commercial phosphoric-acid-containing article; namely, phosphatic slag, Mona guano, apatite, South Carolina phosphate

(floats), and dissolved bone-black. The market cost of each of these articles controlled the quantity applied, for each plat received the same money value, in its particular kind of phosphate.

| | Cost per Ton. |
|---|---|
| Phosphatic slag, | $15 00 |
| Mona guano (West Indies), | 15 00 |
| Ground apatite (Canada), | 6 25 |
| South Carolina phosphate (floats), | 15 00 |
| Dissolved bone-black, | 25 00 |

*Analyses of Phosphates used.*

[I. Phosphatic slag; II. Mona guano; III. Apatite; IV. South Carolina phosphate (floats); V. Dissolved bone-black.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 0.47 | 12.52 | 0.09 | 0.39 | 15.96 |
| Ash, | – | 75.99 | – | – | 61.46 |
| Calcium oxide, | 46.47 | 37.49 | – | 46.76 | – |
| Magnesium oxide, | 5.05 | – | – | – | – |
| Ferric and aluminic oxides, | 14.35 | – | – | 5.78 | – |
| Total phosphoric acid, | 19.04 | 21.88 | 36.08 | 27.57 | 15.82 |
| Soluble phosphoric acid, | – | 0.00 | – | 0.00 | 12.65 |
| Reverted phosphoric acid, | – | 7.55 | – | 4.27 | 2.52 |
| Insoluble phosphoric acid, | – | 14.33 | – | 23.30 | 0.65 |
| Insoluble matter, | 4.39 | 2.45 | 9.55 | 9.04 | 6.26 |

The following fertilizers were applied to the different plats April 17, 1890: —

Plat I. (south side), 6,494 square feet, { 127 pounds of ground phosphatic slag.
43 pounds of nitrate of soda.
58 pounds of potash-magnesia sulphate.

Plat II., 6,565 square feet, { 128 pounds of ground Mona guano.
43½ pounds of nitrate of soda.
59 pounds of potash-magnesia sulphate.

| | |
|---|---|
| Plat III., 6,636 square feet, . | 304 pounds of ground apatite.<br>44 pounds of nitrate of soda.<br>59 pounds of potash-magnesia sulphate. |
| Plat IV., 6,707 square feet, . | 131 pounds of South Carolina phosphate.<br>44½ pounds of nitrate of soda.<br>60 pounds of potash-magnesia sulphate. |
| Plat V., 6,778 square feet, . | 78 pounds of dissolved bone-black.<br>45 pounds of nitrate of soda.<br>61 pounds of potash-magnesia sulphate. |

The phosphatic slag, Mona guano and South Carolina floats were applied at the rate of 850 pounds per acre, apatite at the rate of 2,000 pounds per acre; dissolved bone-black at the rate of 500 pounds per acre. These figures represent approximately the equal local cash values of the different sources of phospheric acid applied. Nitrate of soda corresponds in all cases to an application of 290 pounds per acre, and the potash-magnesia sulphate at the rate of 390 pounds per acre.

The field was planted with potatoes, Beauty of Hebron; the large-sized ones were cut in halves, and the small ones left whole, when planted, May 1, 1890. The rows were three feet three inches apart, and the hills in the rows eighteen inches. Each plat had sixteen rows. The young plants came up quite uniformly; they were cultivated and hoed June 2. Several applications of Paris green with plaster were made during the season, to prevent damage by potato bugs. The crop looked well until the middle of July, when the effects of a serious drought showed itself to such an extent that the maturing seemed to be hastened on by it.

The potatoes were harvested from all the plats August 12 to 14. They were assorted in the field into marketable ones and small ones. The former were sold at sixty cents per bushel; the latter were used for chicken feed, at twenty cents per bushel, — our local market prices.

| No. of Plat. | Total Yield of Potatoes (Pounds). | Marketable Potatoes (Pounds) | Small Potatoes (Pounds) |
|---|---|---|---|
| I. (south end), | 1,600 | 1,215 | 385 |
| II., | 1,415 | 915 | 500 |
| III., | 1,500 | 1,070 | 430 |
| IV., | 1,830 | 1,380 | 450 |
| V. (west end), | 2,120 | 1,590 | 530 |

*Yield per Acre.*

| | | | |
|---|---|---|---|
| I. Phosphatic slag, | 10,671 | 8,087 | 2,584 |
| II. Mona guano, | 9,388 | 6,071 | 3,317 |
| III. Ground apatite, | 9,845 | 7,023 | 2,822 |
| IV. South Carolina phosphate, | 11,886 | 8,963 | 2,923 |
| V. Dissolved bone-black, | 13,626 | 10,218 | 3,408 |

*Statement of Percentages.*

| Plats. | Marketable Potatoes (Per Cent). | Small Potatoes (Per Cent). |
|---|---|---|
| I., | 75.78 | 24.22 |
| II., | 64.66 | 35.34 |
| III., | 71.32 | 28.68 |
| IV., | 75.40 | 24.60 |
| V., | 74.91 | 25.09 |

*Money Value of Crop.*

[One bushel = 60 pounds.]

| Plat. | Marketable Potatoes, at 60 Cents per Bushel. | Small Potatoes, at 20 Cents per Bushel. | Total Sum. |
|---|---|---|---|
| I., | 134.6 bushels = $80 76 | 43.0 bushels = $8 60 | $89 36 |
| II., | 101.2 bushels = 60 72 | 55.3 bushels = 11 06 | 71 78 |
| III., | 117.1 bushels = 70 26 | 47.1 bushels = 9 42 | 79 68 |
| IV., | 149.3 bushels = 89 58 | 48.7 bushels = 9 74 | 99 32 |
| V., | 170.3 bushels = 102 18 | 56.8 bushels = 11 36 | 113 54 |

As a first year's results, the above statements are reported without any further comment, beyond the remark that the dryness of the season renders the advantages of a soluble form of phosphoric acid very striking. The experiment will be repeated during the coming season. Winter wheat has been sown, to continue the inquiry. One year's results cannot furnish a basis for a final decision. The varying accumulation of phosphoric acid in the soil is an important fact, which deserves a serious consideration as the investigation advances.

Plat I. received 24.18 pounds of phosphoric acid.
Plat II. received 28.01 pounds of phosphoric acid.
Plat III. received 109.68 pounds of phosphoric acid.
Plat IV. received 36.12 pounds of phosphoric acid.
Plat V. received 12.34 pounds of phosphoric acid.

The largest yield of potatoes has only removed 3.392 pounds of phosphoric acid from the soil.

*Tabular Statement of the Approximate Amount of Nitrogen, Phosphoric Acid and Potash in the Crop raised.*

| PLATS. | Pounds of Potatoes per Plat. | Pounds of Nitrogen in Tubers. | Pounds of Phosphoric Acid in Tubers. | Pounds of Potassium Oxide in Tubers. |
|---|---|---|---|---|
| I., . . . . . . | 1,600 | 5.440 | 2.560 | 9.280 |
| II., . . . . . . | 1,415 | 4.811 | 2.364 | 8.207 |
| III., . . . . . . | 1,500 | 5.100 | 2.400 | 8.700 |
| IV., . . . . . . | 1,830 | 6.222 | 2.928 | 10.614 |
| V., . . . . . . | 2,120 | 7.208 | 3.392 | 12.296 |

The calculation is based on E. Wolff's average analyses, 1,000 pounds of potatoes containing: nitrogen, 3.4 pounds; phosphoric acid, 1.6 pounds; and potassium oxide, 5.8 pounds.

## X. Experiments with Grass Land, East Field Meadow.

The field assigned for a permanent production of grasses covers an area of from nine to ten acres. The main part of the land is nearly on a level, running from south to north, with a slight descent towards the north. The western side of the field is bordered by a public highway, the eastern by the new orchard of the station. Along the eastern side the grounds are gently sloping towards the centre of the field, and are here and there somewhat springy. The location of the level portion of the field renders it liable to a temporary overflow of water from the hillsides toward the south.

The soil consists largely of a sandy loam of from two to three feet in thickness, here and there resting upon either a layer of hard-pan or of a coarse, gravelly material.

The springy character of the eastern slope, as well as the periodical overflow of water from the hillsides toward the southern end of the field, without any adequate outlet to regulate the supply of water from both sources, had rendered the larger portion of the field an unsightly swamp meadow, covered with a comparatively worthless vegetation, previous to 1887.

The general character of the surface soil, as well as the apparent chances of regulating its state of moisture, promised to make the field, under proper management, in an exceptional degree fit for a permanent meadow.

The first attempt at improvement in that direction was made in August, 1886, soon after the first cut of its growth was harvested. The entire work required to secure satisfactory results was carried out during two succeeding summer seasons, on account of limited financial resources.

After securing the outlet necessary for the accumulating water, through the adjoining lands at the western termination of the field, it was decided to run, from ten to twelve feet apart, two parallel ditches from north to south, through the lowest part of the land. One was dug from three and one-half to four feet below the surface of the ground, to serve as a main ditch for laying drain tiles six inches in diameter, to prevent an accumulation and subsequent stagnation of water

in the upper soil. The other was an open ditch, on an average of from one foot to eighteen inches deep, to assist in a speedy discharge of surface water, due to heavy rains or the melting of the snow and ice on adjoining hillsides in the spring. In both instances the necessary fall was secured to dispose of the surplus water in a desirable degree. One surface ditch sufficed for the whole area; while numerous branch ditches, starting out from the main tile ditch at varying distances from each other, were built at all places where local conditions indicated an exceptional state of moisture. The tiles in the branch drain ditches varied from two to four inches in diameter. The main tile drain at its southern starting point runs into a stone drain ten by twenty feet, which serves as a filter for the turbid water coming from the adjoining hillsides in case of heavy rains before entering the tile drain. The surface ditch runs up to the stone drain to prevent an accumulation of water, and thereby reduces the chances of untimely overflow of the meadow.

As soon as the drain tiles were covered and the ditches as far as practicable levelled, the entire area was ploughed, and the main depressions filled up with stones and earth, or earth, as circumstances advised, and left in that condition over winter.

The succeeding spring a wheel harrow was used to break up the rotten sod. The soil was subsequently repeatedly ploughed and harrowed, until it showed the desirable mechanical condition required for a successful cultivation of summer grain crops.

Barley and oats were chosen as the first crops in case of the meadow north of the new roadway. Both were seeded in drills, with rows two feet apart, to permit a thorough destruction of an objectionable foul growth, by a frequent use of the cultivator and hoe.

As soon as these crops were harvested, one ton of wood ashes per acre was ploughed in, to assist in the disintegration of the excess of organic peaty matter, and to serve as a general fertilizer. Ploughing once more and smoothing the surface by means of a brush harrow, the entire area was seeded down into grass to serve as meadow. The latter was

subsequently cut into two, by a road built for communication to more remote fields. This arrangement caused a division into a northern and southern meadow.

In case of the land south of the roadway, leguminous plants, as soja bean, Southern cow-pea and serradella, served as first crop. The system of drainage and of seeding down remained the same as before. The meadow north of the road covers an area of somewhat more than six acres, and that south of the road is about three acres in size. The meadow north of the road was sown for the first time in the fall of 1887, with grass, and the one south of the roadway in the fall of 1888.

The more elevated portions of both were seeded down with the following mixture of grass seeds, at the rate of from two to two and one-half bushels per acre : —

Two bushels herds grass (*Phleum pratense*).
Two bushels red top (*Agrostis vulgaris*).
Two bushels Kentucky blue-grass (*Poa pratensis*).
Two bushels meadow fescue (*Festuca pratensis*).
Seven pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

Early in the succeeding spring a mixture of equal weights of medium red clover and alsike clover was added broadcast, at the rate of from five to six pounds per acre.

The lower and still more wet portion of the meadow was seeded down with the following mixture of grass seeds : —

Twenty pounds of soft brome grass (*Bromus mollis*).
Twelve pounds herds grass (*Phleum pratense*).
Nine pounds red fescue (*Festuca rubra*).
Eight pounds fowl meadow grass (*Poa serotina*).
Seven pounds Rhode Island bent (*Agrostis alba*).
Six pounds orchard grass (*Dactylis glomerata*).
Five pounds crested dog-tail (*Cynosurus cristatus*).
Four pounds meadow soft grass (*Holcus lanatus*).
Two pounds sweet-scented vernal grass (*Anthoxanthum odoratum*).

From four to five pounds of alsike clover per acre were added by broadcast seeding early in the succeeding spring (1889).

The seed came up well, and suffered but here and there in wet spots during the first winter. Barren spots were reseeded.

Both meadows were cut but once during the first summer season, somewhat later than usual; the majority of grasses did not, as might be expected, head out.

As soon as the first crop of hay was secured, a system of manuring was planned, which would illustrate the comparative manurial effect of top-dressing, as follows: —

By barn-yard manure.
By ground bones and muriate of potash.
By unleached wood ashes.

The northern meadow, consisting of six and one-half acres, was subdivided into three plats, I., II., III., running from east to west, leaving a space of twenty feet in width between them without any manurial matter.

The southern meadow was divided into two plats, IV., V. (south end). Plats I., II., III. were sown down in grass during September, 1887, and plats IV. and V. during September, 1888. The subsequent stated system of manuring began in the autumn of 1888, on all plats at the same time.

Plat I. (north end of the field) is equal to 1.92 acres. It was top-dressed during the fall and early spring with barn-yard manure, at the rate of eighteen tons per acre (1888–89).

Plat II. covers a similar area as Plat I. (83,640 square feet). It received at the same time a top-dressing of barn-yard manure, at the rate of eight tons per acre (1888). The coarsest part of the barn-yard manure was subsequently removed from both plats before the growing grass interfered with its being raked off.

Plat III., about 2.41 acres, received, May 3, 1889, a top-dressing of six hundred pounds of fine-ground steamed bone and two hundred pounds of muriate of potash per acre.

Plat IV. (south of roadway), an area of 2.11 acres, received the same dressing, in the same proportion and at the same rate (six hundred pounds ground bone and two hundred pounds muriate of potash) per acre, as Plat III. (1889).

Plat V., equal to .91 acres, received as top-dressing, April 23, 1889, one ton of unleached Canada wood ashes, from our local market (1889).

*Yield of Hay in Case of Plats I., II. and III. (Second Year after Seeding), and of Plats IV. and V. (First Year after Seeding).*

| Plat I. | First Cut. | Second Cut. |
|---|---|---|
| 1.92 acres, . . | 10,500 pounds, June 24. | 4,370 pounds, August 26. |

Total yield per acre, 7,745 pounds, or 3.87 tons.

| Plat II. | First Cut. | Second Cut. |
|---|---|---|
| 1.92 acres, . . | 9,130 pounds, June 24. | 4,650 pounds, August 26. |

Total yield per acre, 7,177 pounds, or 3.59 tons.

| Plat III. | First Cut. | Second Cut. |
|---|---|---|
| 2.41 acres, . . | 12,200 pounds, June 24. | 4,950 pounds, August 26. |

Total yield per acre, 7,116 pounds, or 3.56 tons.

Plat IV. (2.11 acres); Plat V. (.91 acres): The first year's hay consisted nearly entirely of herds grass, which was almost the only variety which had headed out in June. The yields of both plats were harvested together.

| First Cut. | Second Cut. | Total Yield per Acre. |
|---|---|---|
| 8,130 pounds, June 24. | 3,105 pounds, August 31. | 3,720 pounds, or 1.86 tons. |

*1890.*—The different plats were prepared in a similar manner for the season of 1890 as they had been for the preceding season, 1889.

Plats I. and II. received a top-dressing of barn-yard manure during the months of October and November; the former

at the rate of fourteen tons per acre, and the latter at the rate of eleven tons.

Plat III. was treated in April, 1890, as before, with a mixture of six hundred pounds of fine-ground bones and two hundred pounds of muriate of potash.

Plats IV. and V. were merged into one plat, and received a top-dressing of unleached wood ashes, at the rate of one ton per acre, April 19, 1890.

Barren spots in this plat, it being the second year after seeding down, were reseeded by the same seed mixture which had been used before.

The entire meadow received an addition of from two to three pounds of alsike clover seed, broadcast, per acre.

All plats were cut as far as practicable at the same time.

*Yield of Hay in 1890.*

| Plat I. | First Cut. | Second Cut. |
|---|---|---|
| 1.92 acres, . . | 14,625 pounds, July 1. | 3,790 pounds, Sept. 1. |

Total yield of hay, 18,415 pounds.
Yield per acre, 9,591 pounds, or 4.80 tons.

| Plat II. | First Cut. | Second Cut. |
|---|---|---|
| 1.92 acres, . . | 12,480 pounds, July 1. | 3,105 pounds, Sept. 3. |

Total yield of hay, 15,585 pounds.
Yield per acre, 8,117 pounds, or 4.06 tons

| Plat III. | First Cut. | Second Cut. |
|---|---|---|
| 2.41 acres, . . | 14,460 pounds, June 26. | 3,535 pounds, September. |

Total yield of hay, 17,995 pounds.
Yield per acre, 7,466 pounds, or 3.73 tons.

*Yield of Hay in 1890* — Concluded.

| PLAT IV. (IV. and V., 1889.) | First Cut. | Second Cut. |
|---|---|---|
| 3 acres, . . | 13,380 pounds, July 1. | 4,080 pounds, Sept. 3. |

Total yield of hay, 17,460 pounds.
Yield per acre, 5,820 pounds, or 2.91 tons

The total yield of hay on plats I., II. and III. averages 4.19 tons per acre. The total yield on Plat IV. averages 2.91 tons per acre.

The weight of the second cut of hay (rowen) averages about one-fourth of that of the first cut. The dryness of the season during the latter part of July affected seriously the yield of the second cut. The wet season of 1889, as compared with the dry season of 1890, as well as the difference in the age of the two meadows, renders further comparison not advisable at this early stage of our investigation.

## XI. Report on General Farm Work.

Aside from the experimental work described within the preceding pages, much has been accomplished in other directions.

Some of this work is of a mere preparatory character, and will be reported in due time in connection with a detailed description of the experiment with which it is connected. The remainder concerns merely current farm work, as may be seen from a few subsequent statements.

The new orchard, covering an area of from six to seven acres, has been in part planted with apple, pear, peach and plum trees; other varieties, as well as small fruits, will be planted during the coming spring.

Several acres were sown with vetch and oats, soja bean and corn, to furnish green fodder for the dairy, and to serve as ensilaged crops for winter feed.

One silo is filled with fodder corn, and another with half soja bean and half fodder corn.

It has been the aim to improve the productiveness of the farm lands, wherever circumstances admitted a free choice of suitable means. To produce a variety of fodder crops has been the leading object of the general management.

The subsequent statement contains an enumeration of the principal crops raised in different parts of the farm, on lands either permanently assigned for the production of fodder for the live stock of the station, or engaged in a course of preparation for future experiments: —

| | | |
|---|---|---|
| Hay (first cut), | $46\frac{1}{2}$ | tons. |
| Rowen (second cut), | $12\frac{1}{2}$ | " |
| Fodder corn, | $5\frac{1}{2}$ | " |
| Roots (carrots, $4\frac{1}{2}$ tons; sugar beets, 3 tons), | $7\frac{1}{2}$ | " |
| Scotch tares (dry), | $1\frac{1}{3}$ | " |
| Barley (grain, 430 pounds; straw, 1,200 pounds), | $\frac{4}{5}$ | " |
| Oats (grain, 1,250 pounds; straw, 2,000 pounds), | $1\frac{3}{5}$ | " |
| Vetch and oats (green), | 4 | " |
| Soja bean (green), | 10 | " |
| Corn for ensilage, | 18 | " |
| Potatoes, | 190 | bushels. |
| Flax, | 670 | pounds. |
| Miscellaneous fodder crops, | $1\frac{1}{2}$ | tons. |

## XII. Department of Vegetable Physiology.

Report by Prof. James Ellis Humphrey.

The past year has seen the department finally settled in the new quarters provided for it, and fairly equipped for work. Owing to repeated delays, the new laboratory was not occupied until the middle of March, and the greenhouse was completed so late that it did not become practically available until fall. Therefore the present contains no reports of greenhouse work. What has been done the past fall consists of preparations for and the beginnings of experiments not yet completed, and is reserved until results can be reported.

The work of the past year here reported upon consists of laboratory and field studies of several diseases which cause very severe losses to farmers and fruit growers, or of the fungi which cause them, as follows:—

1. The black knot of the plum.
2. The mildew of cucumbers, etc.
3. The brown rot of stone fruits.
4. The potato scab.
5. Notes on various diseases.

Reference to the "General Account of the Fungi," in the last report of this station, will be found of assistance to a full comprehension of the following discussions.

### The Black Knot of the Plum. — *Plowrightia morbosa* (Schw.) Sacc.

For a hundred years complaints have come from one or another part of the United States of the destruction of plum and cherry trees through the attacks of a conspicuous and fatal disease, which shows itself in the formation of dark, rough excrescences upon the limbs or even on the trunk of the tree.

These growths increase both in size and in number, spreading from branch to branch and from tree to tree, in a manner strongly suggesting their contagious nature; and

their striking appearance has given to the disease the name by which it is too well known, "the black knot," or "plum wart."

The cause of this disease has been the subject of much discussion and of innumerable contributions to agricultural journals, from an early date. Some of the first remarks on the subject are to be found in an article by Prof. W. D. Peck of Cambridge.* The appearance of the knot is here attributed to the same insect which causes the falling of the fruit, now called the "curculio." This insect was believed to injure the branch in such a way that, as the writer says, the sap is diverted to the bark, which absorbs it and swells, forming the knots. The general theory here promulgated, that of an *insect* cause, was for over fifty years very tenaciously held and earnestly supported, and indeed is still held by many persons, although wholly discredited by scientific study. The fact that eggs or larvæ of the curculio are very commonly found in the tissue of the knot has been a strong argument with many in support of Peck's theory; but others, while holding to the general belief in an insect cause, have believed the knots to be due to some species of gall fly (*Cynips*), since none of the beetles, including the curculio, are known to be gall-producing insects. Thus argued the entomologist, B. D. Walsh, in an early paper.† But the difficulty here lies in the fact that no gall fly has been found in or raised from a knot.

Several writers have attributed the trouble to that conveniently indefinite cause, — a diseased condition of the sap; and Dr. Fitch, the former New York State Entomologist, held the disease to be of internal, "constitutional" origin. Quite early, Dr. Joel Burnett of Southborough discussed ‡ the question, showed that the curculio merely lays its eggs in the juicy mass of the knot, after it is formed, and attributed its formation to the attacks of a fungus. This is, perhaps, the earliest statement of this

* Mass. Agric. Repository, 1819, p. 307.

† Proceedings Entomol. Soc. Philadelphia, Vol. III, p. 613 (1864).

‡ Hovey's Mag. of Hortic., Vol. IX, p. 281; and N. E. Farmer, 16 Aug., 1843, p. 49.

view in a popular form, although the knots and the accompanying fungus had already been described by the pioneer student of American fungi, de Schweinitz, who appears to have regarded the knots as the combined result of the attacks of a gall fly and the fungus, to which he gave the name *Sphæria morbosa*.* In 1831 he described, in his "*Synopsis Fungorum in America Boreali media digentium*," the destruction of both wild and cultivated varieties by the disease. The distinguished entomologist, Dr. T. W. Harris, in his earlier writings advocated the view that the knot is caused by insects; but later † he mentions the fungus, which, he says, is sure to appear on the knots, and never elsewhere, though he does not commit himself fully to the theory that the disease is of fungous origin. In 1862 the editor of the "Gardener's Monthly," Mr. Thos. Meehan, took strong ground in favor of the fungous origin of the disease, and for several years following a spirited discussion of the subject was carried on by various correspondents in the columns of his journal. At about the same time it was logically argued, in the "Country Gentleman," that, even though insects were found in ninety-nine knots, the finding of the hundredth one free from them would be sufficient to show that they could not be the *cause* of the disease.

Mr. C. F. Austin gave ‡ what appear to have been the first account and illustrations of the microscopic structure of the knot fungus. Entomological writers now began rapidly to accept the fungus theory of the origin of the knots, as is shown by papers from Glover,§ Walsh‖ and Riley.¶ Walsh gives at considerable length an account of the supposed structure and life history of the knot fungus, so wholly unlike what we now know of it that it is impossible to conjecture what he could have seen. Up to 1872 knowledge of the fungus was very meagre, and confined to the winter spores to be described later. In that year Prof.

* Synopsis Fungorum Carolinæ superioris, no. 134 (1821).
† Insects Injurious to Vegetation, 2d ed., p. 69 (1852).
‡ Amer. Agriculturist, 1863, p. 113.
§ U. S. Agric. Report, 1863, p. 572.
‖ Practical Entomologist, Vol. I, p. 48, and Vol. II, p. 63 (1866-67).
¶ Gardener's Monthly, November, 1866, p. 331.

C. H. Peck, New York State Botanist, gave the first correct account * of some details of the structure of *Sphæria morbosa*, then first describing the summer spores and the time of maturity of the winter spores. In 1875 Dr. Thos. Taylor gave † an illustrated account of the fungus, which was incomplete and incorrect in several particulars, and added nothing to previous knowledge.

Now followed the fullest and best account we have of the structure and life history of this fungus, which was held to be the sole cause of black knot. It was by Dr. W. G. Farlow ‡ of Harvard University, and remains the authoritative account of the disease and its cause, to-day. The author described the summer and winter spores, and, as will be noticed later, other secondary forms, and figured the various organs. This paper has served as the basis of the present, as it must of all work on the black knot; but its comparative inaccessibility renders the repetition of certain descriptions and illustrations not superfluous in connection with the new facts to be presented here. Since its publication, the authority of this paper as to the cause of the disease has remained unquestioned, and all conflicting theories have fallen into discredit among scientific students and observers.

The black knot is known to attack nearly all our wild or cultivated species of plums and cherries: but, so far as the cultivated fruits are concerned, the plums are by far the greater sufferers. It has been thought there must be two or more species of fungi which produce the knots on different host-species. Walsh, for instance, considered that there are two fungi, one attacking the plum and the other the cherry; and a reviewer of his paper suggested a third on a species of wild plum. Others have based arguments for this opinion chiefly on the fact that certain hosts sometimes suffer from epidemics of the black knot, while others, equally liable to its attacks, remain free.§ De Schweinitz

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* A Paper on Botany, read as a Report before Albany Inst., Feb. 6, 1872.

† Monthly Micros. Journal, Vol. XIII, p. 118, with two plates; London, March, 1875.

‡ Bulletin Bussey Institution, Part V, p. 440, with three plates (1876).

§ See Gardener's Monthly, November, 1866, p. 335.

has mentioned * an instance of the sort as having occurred at Bethlehem, Penn. Soon after 1790, the very abundant trees of what he calls "Amarellæ," probably morello cherries, were nearly all destroyed by the knot; while a second visitation, about 1830, swept off most of the plum trees. Many farmers and fruit growers will recall similar cases in their own experience. In spite of these facts, however, there is no evidence that there is more than a single species of knot fungus, which attacks both plums and cherries; and we must probably seek other causes for its occasional selection of particular hosts, to the exclusion of others equally susceptible.

As has been the case with many cultivated plants, certain varieties of plums have been claimed by originators or dealers to be disease-proof. As early as 1843, Messrs. W. R. Prince and Co., nurserymen of Flushing, N. Y., published in the "New England Farmer" a list of varieties claimed by them to be not subject to the black knot, with the remark that they were all varieties of American origin. A few months later, a brief editorial note in the same paper stated, on the authority of prominent growers, that the list was of no value for the vicinity of Boston. And similar claims have usually met a similar fate.

This fungus is strictly American in origin, and has not yet, so far as has been reported, been introduced with its host plants into Europe, as have so many other American fungi. But in the United States it is very widely distributed, ranging from Maine to California, and from Wisconsin to Texas, where it is said to be rare. In most parts of the country it is abundant and destructive.

As above stated, the fungus was first described and named as *Sphæria morbosa* Schw. Various writers have proposed various other generic names as better indicating its relationships, but none of these was generally adopted until Saccardo, regarding it as a member of the family *Dothideaceæ* of the "Black Fungi" (*Pyrenomycetes*), called it *Plowrightia morbosa* (Schw.) Sacc., by which name it is now commonly known.

* Synopsis Fungorum Amer. Bor. Proc. Amer. Phil. Soc., Vol. III, p. 269.

The knot may first be observed in the fall as a slight swelling of the branch, arising near an old knot, or independently. If near a knot, it is probably caused by the extension of vegetative threads from the latter; but, if on a branch not before attacked, it is probably due to infection by spores from an earlier knot. A section across such a young knot shows that the swelling has taken place wholly in the bark and largely in the inner bark (Phloëm), in which may be seen radially placed bundles of the fine, intertwined threads of the fungus. The swelling continues in the spring, and the epidermis ruptures, allowing the protrusion of the dark, greenish-brown mass of tissue, presumably due to abnormal growth induced by the irritation caused by the presence of the fungus. This mass is firm and succulent, and its surface is usually irregularly cracked and granular. In May there are developed over this surface numerous short, erect threads, standing rather closely together, like the threads in the "pile" of velvet, and giving to the surface a dark-brown, velvety appearance. On these threads are borne, at and near their tips, the summer spores of the fungus, obovate bodies of a brownish tint. (Fig. 6.)

Toward midsummer these threads and spores disappear, and, in consequence, the knot loses its velvety appearance and brownish shade, and becomes dead black in color. It also becomes hard and dry, and the larvæ of insects whose eggs were laid in it when it was young and juicy have already begun to destroy its interior, so that very often only the outer crust finally remains. In this fact is to be found the basis of the stoutly defended theories of the insect origin of the knot already alluded to. The surface of the knot may now be seen to be checkered off into little rounded areas, each of which has a slight depression at the centre. In some cases, these black areas do not completely cover the surface, but leave intervening brown spaces. If a section be made across the knot in the fall, a year after its first appearance, under each of the black areas described may be seen with the unaided eye a white spot, which marks the position of a cavity in the dense, black fungus-tissue. This is filled with slender, colorless

threads, as the microscope shows. Later, there appear in these cavities, among the slender threads, club-shaped structures, in each of which are gradually developed eight colorless winter spores, which become ripe and capable of germination by the middle of January. Crozier gives * a considerably later date for the maturity of the spores in Michigan; but the above, given by Dr. Farlow for eastern Massachusetts, has been found by the writer to be also correct for Amherst. These spores may continue in the cavity for some time, but eventually escape, probably by a pore formed at the central depression before mentioned. A fully developed knot ordinarily shows no spores remaining by late spring or summer.

Fig. 1 shows a magnified section through three of the spore cavities or *perithecia* of the fungus, containing the club-shaped spore-sacs or *asci*. In Fig. 2 are represented two spore-sacs, with their contained spores, and two of the sterile threads or paraphyses among which they grow.

When obtaining the winter spores in quantity by scraping the freshly cut surface of a section across many perithecia, I have nearly always found mixed with them a small proportion of the globular or slightly elliptical brownish bodies shown at Fig. 4, *a*; but I have not yet met with them in spore cavities.

Studies of the development of the three above-described spore forms have been carried on in the laboratory with interesting results. The following account gives a general outline of the progress and present status of the work. After its completion, a detailed account of the investigations, with their results, both theoretical and practical, will be published, with full illustrations, in a suitable form.

The winter spores, when sown in water and kept in a moist chamber, begin to germinate so promptly that they show germ tubes of some length at the end of one day (Fig. 3, *a*): while in two days as many as three threads, one of which has taken the lead, as a rule, and has become several times as long as the spore, may have developed (Fig. 3, *b*). The principal threads usually originate from

* Botanical Gazette, 1885, p. 368.

the larger of the two spore cells, though in exceptional cases one from the smaller cell may take the lead (Fig. 3, *b*). The threads may originate from any point on the surface of either cell.

The brown spores which occur with the winter spores germinate even more promptly than the latter, and may produce in two days threads whose length is ten or fifteen times the diameter of the spores (Fig. 4, *c*).

When sown on nutrient gelatine, prepared with an infusion of prunes, and kept in a moist chamber at the ordinary temperature of the laboratory, the winter spores produce abundant threads, which grow and branch rapidly, forming a close felt, which begins, in four or five days, to show a dark fuscous-brown tint. This color deepens and spreads, and there arise on the threads, in six or seven days, small black bodies, projecting somewhat above the surface of the gelatine. These present, when viewed under the microscope, from above, the appearance shown in Fig. 9, from which it will be seen that their exterior is composed of a close layer of angular cells, interrupted in the middle and highest part by an opening or mouth, which is fringed by a circle of radiating threads. It may be observed that spores escape from the interior of the body through this mouth in the form of a long, snake-like thread or *cirrhus*, consisting of innumerable spores, imbedded in a transparent, gelatinous substance. If a portion of this thread be placed in water, it becomes disintegrated by the rapid swelling and solution of its gelatinous basis, thus leaving the spores free. These bodies, which are evidently reproductive organs of the type known as *conidial fruits*, are of an approximately globular form, usually somewhat flattened, and with a slightly projecting mouth, as a vertical section (Fig. 10) shows. The wall is several cells thick, the membranes of the outer cells being rather thick and dark colored, while those of the inner cells are thin and delicate, with a tendency to become gelatinous. It is probable that the gelatinous substance of the spore cirrhus arises, in the present, as in other cases, by the breaking down of the innermost cells of the wall of the cavity. The spores are produced (Fig. 10) by budding from the interior cells of

the wall, and, when fully developed, fall from their attachments and become free in the central cavity. These spores correspond in all respects with the brown spores before mentioned as found in small numbers with the winter spores. The latter are undoubtedly developed in special spore cavities, corresponding in structure to those developed on gelatine, which occur sparingly among those producing winter spores (*ascospores*). But I have not yet been able to recognize them in sections of the knot. From the fact stated it becomes probable that this hitherto undescribed fruit form is the *pycnidial* fructification of the black-knot fungus, and it may be seen that it corresponds in general with the known *pycnidia* of related fungi.

The spores, which we may designate *pycnospores*, taken from pycnidia developed on gelatine, germinate in water as promptly and in the same way as those from the knot (Figs. 4 and 5). When sown on fresh nutrient gelatine, their threads develop much more rapidly and branch more freely than in water, as may be seen by a comparison of Figs. 5, *c*, and 5, *d*. On gelatine the spots formed by the masses of dark threads become evident to the unaided eye in eight or nine days, and new pycnidia and pycnospores are produced in from nine to ten days, a slightly longer time than that required for their development from the winter spores. I have not yet succeeded in obtaining perithecia with winter spores from cultures.

Dr. Farlow describes, in his paper, quoted above, four kinds of spore-fruits, as follows: (1) those producing winter spores (*ascospores*) in sacs; (2) those producing bodies which he terms *stylospores*, which form has since been named, by Saccardo,* *Hendersonula morbosa;* (3) spore-fruits of the type usually known as *spermogonia;* (4) others which he calls *pycnidia*, which differ essentially, however, from the pycnidia above described. Of these forms the third has not been met with in course of my studies, but it is yet too early to say it is not likely to be found. I have seen, in a few sections, small spore-fruits among the perithecia, which may be identical with Dr.

* See Sylloge Fungorum, Vol. III, p. 445.

Farlow's *pycnidia*, above mentioned. They have oblong or triangular cavities, lined with layers of small cells, from which are produced large numbers of nearly colorless, oval spores, about half as long as the pycnospores developed on gelatine. I have not been able to see that they are developed on short threads, as is said by Dr. Farlow to be the case with the spores in his pycnidia. Should this form be proved to belong to the life cycle of the knot-fungus, it will constitute its second pycnidial stage.

The *Hendersonula* or stylosporic form described by Dr. Farlow, which would constitute a pycnidial form, according to present terminology, has also not been found even to the extent of a single spore, though very careful and thorough search has been made for it. It is also to be expected that, if it were a genuine pycnidial stage of the fungus, it might be produced on cultures, as the pycnidia above described have been. This total failure to find the form has led me to give it up as a feature in the developmental history of *Plowrightia morbosa*. On consultation with Dr. Farlow, he has kindly permitted me to say here that he does not think there is sufficient evidence that this form is really a stage of the knot-fungus, although it frequently occurs with it.

The summer spores, when sown on prune gelatine, swell to an elliptical form, resembling that of the pycnospores, and germinate by producing threads (Fig. 7). These also form close, felted patches, and assume, after a time, the characteristic dark color before mentioned; and send up, finally, erect threads, which bear conidial spores like those from which they have grown (Fig. 8). No other form was developed on these cultures, even after a long time.

While considerable work remains to be done in deciding the connection of doubtful spore forms, and in completing the structural history of this pleomorphic fungus, the most important work now remaining is the investigation of its relations to its host plants. How it attacks them, how the knots begin to develop, and the history of their development, are the subjects which most need investigation now. This Department has not heretofore been prepared for this study, but the necessary preparations have been

made during the past season, and it is hoped that the work of the coming year may shed some light on these questions, which bear so directly and so practically on the treatment and prevention of the disease.

### THE CUCUMBER MILDEW. — *Plasmopara Cubensis* (B. & C.).

In 1868, Berkeley and Curtis described* a fungus of the *Downy Mildew* group from specimens on a cucurbitaceous plant from Cuba, under the name *Peronospora Cubensis.* This fungus remained then comparatively unknown for twenty years; but meanwhile Spegazzini † had described a species on a cucurbitaceous host from the Argentine Republic, which he called *Peronospora australis*, and Trelease ‡ found the same species on the one-seeded star cucumber (*Sicyos angulatus*), in Wisconsin.

In 1889 Dr. W. G. Farlow § reported having received from Japan the previous year a fungus on cucumber leaves, and in 1889, from New Jersey, the same fungus on the leaves of hot-bed cucumbers. The same fungus appeared during 1889 on leaves of cucumbers and squashes in various parts of the country, and seemed likely to become a serious pest. The structure of the fungus is quite different from that of the only mildew heretofore known on *Cucurbitaceæ* in the United States, namely, *Peronospora australis* (compare Figs. 11 and 15); but a comparison with original specimens of the little-known *P. Cubensis* has shown it to be undoubtedly that species. Its almost simultaneous discovery in widely separated parts of the earth, where it had previously been wholly unknown, is a remarkable instance of the apparent vagaries of fungous epidemics, and shows how much we have yet to learn of the conditions which govern them.

This fungus attacked with fatal result a plot of cucumbers in Amherst the past season, and was received on

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* Journal Linnæan Society, Botany, Vol. X, p. 363.

† Annales Sociedad Cientif. Argentina, 1881, XII, p. 81.

‡ Botanical Gazette, 1883, p. 331; see also Paras. Fungi Wisconsin, p. 6.

§ Botanical Gazette, 1889, p. 187.

squashes from Mr. S. F. Libby of Milford, Mass., who reported it as killing the leaves completely, and thus stopping the growth of the plant and its fruit. It is unquestionable that farmers and gardeners have here a new and serious hindrance to the successful cultivation of squashes and cucumbers; and there is no reason why it should not extend to melons also. The fungus has never been figured, so far as I am aware, and some facts in regard to its structure are yet lacking. It is, therefore, thought worth while to supply some of these deficiencies here, with figures, for comparison, of the mildew of the wild star cucumber, which may also, very possibly, be found on cultivated *Cucurbitaceæ* in the future.

The vegetative threads of *P. Cubensis* and of *P. australis* do not differ essentially from those of other downy mildews, and ramify among the cells of the host plant, sending into these cells at intervals absorbing organs or *haustoria*, by means of which they abstract nourishment from them, and weaken or ultimately kill them. Among the downy mildews we meet two types of these haustoria. In the grape-vine mildew and others, they are small, knob-like outgrowths from the fungus threads, merely large enough to reach the interiors of the cells of the host; while in others, like the mildews of the turnip and of spinach, mentioned later, they are large and branching, and often nearly fill the cells within which they are developed. In both of the species under discussion the haustoria are of the first type, as shown in Figs. 14 and 16. The haustoria of *P. australis* have been said to grow often large, sometimes filling the cell, but I have observed none such. From the vegetative threads grow out through the pores in the epidermis of the leaf, chiefly on its under surface, the threads which bear the summer spores or *conidia*. Those of *P. Cubensis* are quite scattered over the yellow and dead-looking spots caused by the development of the fungus in the leaf, and do not form a close felt visible to the naked eye, as do so many mildews, because it is rare that more than two of the conidial threads issue from a given leaf pore (Fig. 12). *P. australis*, on the contrary, forms dense white tufts of small extent on the

leaves of the star cucumber, because its conidial threads are developed in large numbers from each of a number of closely situated leaf pores. The structure of the spore-bearing threads in the two species is strikingly different, and furnishes the essential means of distinguishing between them. The details of this structure and the chief differences may best be understood from Figs. 11 and 15. Correlated with the development of small haustoria is frequently found, as in the grape-vine mildew and in *P. australis* (Fig. 15), a pinnate branching of the conidial threads, and conidia with an apical papilla, which germinate by producing *zoöspores* instead of a tube. In *P. Cubensis* we have the anomaly of conidial threads which follow the type of branching usually seen in the species with branched haustoria, and conidia of a violet tint, such as are almost unknown except among the latter group; while the haustoria are small, and the conidia have the apical papilla, and produce zoöspores on germination. This species goes far to break down the distinctions held by some writers to exist between the two groups which constitute the genera *Plasmopara* and *Peronospora* of recent writers, though all formerly included in *Peronospora*. If the distinction is to be maintained on the basis of the germination of the conidia, we must then call these two fungi *Plasmopara australis* (Speg.) and *Plasmopara Cubensis* (B. & C.). The formation of resting spores has not been observed in either species, yet it is evident that they have some means of surviving the winter. This is equally true of a considerable number of mildews; and the problem of what substitutes for resting spores certain species possess is one of the most interesting and important ones connected with these fungi.

This Department wishes to investigate all diseases affecting cucumbers, squashes and melons, cultivated either in the open air or under glass, and to this end urgently requests all persons who suffer from any disease of these crops to send specimens, with details as full as possible, to the writer, as soon as it appears.

## The Brown Rot of Stone Fruits. — *Monilia fructigena* Pers.

The fact that great and sometimes almost total losses of the crop occur among the stone fruits, the peach, plum and cherry, through the attack of this disease, has been for some time recognized, more generally, perhaps, in this country than in Europe. Its effects have been described at some length by some European writers on plant diseases, while by others it is barely mentioned. So far as its general characters and cause are concerned, it has been pretty fully described by Peck,* Arthur,† Galloway‡ and Smith,§ and a brief summary will suffice here.

The disease is at first characterized by the browning of the fruit, whose flesh then becomes shrunken and shrivelled to a thin, tough pellicle over the stone, and remains in this condition and resists decay for an indefinite period. The term "mummied" aptly describes fruits which have been thus affected. Soon after it first turns brown, there may be seen thickly scattered over the surface of the fruit the ashy spore tufts of the fungus which has been shown to be the cause of the disease, and is known as *Monilia fructigena* Pers. The vegetative threads of this fungus ramify through the tissues of the fruit and break through the surface, where they produce spores in chains at their ends. When cultivated in the laboratory, these chains often reach a very great length, and branch more freely than is the case out of doors (Figs. 17–19). It may be easily observed on such specimens that the spores are formed by a sort of budding, the terminal one being the newest; and that where branching occurs it originates in a terminal cell, which assumes a somewhat triangular form, and buds from its two outer angles, as shown in Fig. 18. The spores, when fully formed, fall from the chains, and are capable of immediate germination. Under suitable conditions their germ threads can penetrate the uninjured skin of fruits, or

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* Thirty-fourth Report N. Y. State Museum, p. 35 (1881).

† Fourth Report N. Y. Agric. Exp. Station, p. 254 (1885).

‡ Report U. S. Dep't. Agr., 1888, p. 349. and Plates V and VI.

§ Journal of Mycology. Vol. V, p. 123 (1889).

the tissues of flowers or even of leaves and young twigs, killing and browning all the tissues which they penetrate, and rapidly spreading. Finally, these threads come to the surface, and produce a new crop of spores.

Besides the stone fruits, this fungus is known to attack the apple, pear and others; but its destructive effects seem to be chiefly confined to the first named. My attention was called, in July, 1890, to a loss of early peaches, amounting to a very large percentage of the whole crop, in a small orchard of the Massachusetts Agricultural College, just following several days of warm and moist weather. The wholesale rotting then in progress was sufficient proof that the germ threads of the fungus can penetrate the uninjured skin of the peach, a power which has been doubted by some writers, though lately proved in laboratory cultures by Smith; for it is not to be supposed that most of the fruits on a tree were sufficiently injured to admit the entrance of germ threads otherwise unable to penetrate them. The mummied fruits usually remain hanging upon the branches, or lie, without decaying, on the ground beneath, until the following spring, when, as Smith has shown, the fungus threads, which have lain dormant through the winter, begin, under the influence of warmth and moisture, to grow again, and soon the apparently dead and harmless remains are covered with the ashy spore tufts, which will infect the new season's crop.

That the fungus does winter over in the dried flesh of its victims was further shown last April, by placing mummied plums, picked from the branches where they had hung all winter, before the weather was sufficiently warm to have caused any development, in a moist chamber in the laboratory. In two days the plums were thickly covered by the spore tufts of the fungus. A microscopic examination of the dried flesh from such plums just removed from the tree showed the presence of numerous threads, composed of large, thin-walled cells (Fig. 20, *a*), and of single thick-walled cells of somewhat varying form, which are probably to be regarded as the resting vegetative cells, known as *Chlamydospores* or *Gemmæ* (Fig. 20, *b*). It is probably these cells especially which are able to withstand

the unfavorable conditions of winter, and germinate again when circumstances favor once more. They have been shown to be able to retain their vitality for a long time, under certain circumstances, but it would seem that the dry air of a room is fatal in a comparatively short time; for plums of the previous season, picked April 1, and kept till November 1 in a dry pasteboard box, in a closet, failed entirely to produce the fungus in a moist chamber, though given abundant opportunity to do so. Galloway states that spores of the fungus collected in July, 1886, germinated in May, 1888, but does not state how they were kept meanwhile.

It has often been supposed that *Monilia* represents simply the summer spore form of some fungus whose other stages may be found on other substances. With a view to getting some light on this question, several cultures of the *Monilia* spores have been made on nutrient gelatine, prepared with an infusion of prunes; and one was continued for four and a half months, without, however, producing any other than *Monilia* spores, which appeared in three days after the beginning of the culture. These facts, and the abundant demonstration of the ability of its vegetative threads to survive the winter, apparently through the formation of resting cells or *Gemmæ*, point to the probability that, whatever its origin, any other forms once connected with it have been lost, and it is therefore fairly safe to regard it as an autonomous fungus. Other points of theoretical interest came up during the progress of the cultures, which will be discussed in a technical journal.

Assuming that the *Monilia*, which is classed among the imperfect fungi, is an independent form, and that the simple course of development sketched above constitutes the whole of its life cycle, the problem of avoiding to a large degree the losses now annually caused by it becomes a comparatively simple one. While something can probably be done by judicious spraying with fungicides, the question is largely one of orchard hygiene. If fruit growers could be made to realize the power for harm which lies in a few mummied fruits, they would readily understand that the prompt removal of every one which shows a

trace of this disease is the first necessity, and that the expense involved in a frequent inspection of the orchard during the fruiting season, and the thorough removal of all diseased twigs and fruits at the close of the season, would be manyfold repaid in the increased returns. The caution cannot be too often repeated, that all plants or parts of plants attacked by fungi should be burned at once, in order to completely destroy all spores contained in or upon them, and so prevent their becoming a source of infection. Of course, where several orchards lie in the same neighborhood, the owners of all must co-operate, to secure the best results; but if this were done, and all orchards put into a thoroughly healthy condition every fall, the losses from this and some other diseases would hardly be worthy of mention. The pathologist can do no more; and, if the cultivator will persist in the old uncleanly and wasteful way, let him take the consequences, and blame no one else.

## Potato Scab.

Field experiments in continuation of those of 1889, and on lines suggested by the experience of that year, were carried out during the past season under fairly favorable conditions; and the results, though almost wholly negative, are not without practical value.

After the harvesting of the crop in 1889, the plot devoted to potato experiments was ploughed, and its southern half, including sections 1 to 14, was sown with winter rye, in order that it might have, as far as possible, the character of sod land when ploughed in the spring. The rye came up and made good growth before the close of the season. In the spring it was in vigorous growth, and eight inches high when the plot was again ploughed, May 7. The whole plot was dressed with bone and potash, in the same amounts as in the previous years, and this dressing and the green rye were harrowed in.

Seven varieties of potatoes had been obtained in quantity from Mr. G. D. Howe of North Hadley, together with small sample lots of six other varieties. The chief varieties were the Monroe County Prize, Quinnipiac, Triumph,

White Seedling, Houlton Rose, Hampden Beauty, and Rural New Yorker, No. 2; while those of which small samples were received were Howe's Premium, Rough Diamond, Northern Spy, Early Market, Golden Flesh and Dakota Red. Retaining the same division into sections as was used last year, each of the principal varieties was planted in drills on four sections, except the Monroe County Prize, which was planted on only three sections, thus leaving one section, No. 14, for the samples, of each of which half a row was planted. The chief varieties were so arranged that two sections of each were on that half of the plot which had been sown to rye, and two on the other half; and so that one row of each was planted somewhat deeper and one considerably deeper than the usual depth of planting. All the varieties grew well and received the proper cultivation. In spite of the considerable interval between the maturity of the Triumph, the earliest, and that of the Rural New Yorker, the latest, all were allowed to remain in the ground until the last was matured, and were dug on the 16th and 17th of September. The crop was much better than that of 1889, and markedly less scabby. The results need not be given in full detail, since this would involve unnecessary repetition. It is sufficient to say that they fully warrant, so far as they go, the following statement, which must, however, be given no more weight than that due to a single experiment.

1. The only variety which showed no scab was the Rough Diamond, which, however, has few other features to recommend it, and seems interesting chiefly as a curiosity.

2. The best varieties, both in the general character of the crop and in their comparative freedom from scab, were the Rural New Yorker and White Seedling.

3. The ploughing-in of winter rye produced no perceptible effect on the scabbiness of potatoes raised on that half of the plot, as compared with the other half.

4. The comparison of results from deep and shallow drills does not bear out the opinion, doubtfully expressed last year, that deep planting diminishes scab. Neither for any single variety nor for the plot as a whole was any

distinct advantage in this respect noticeable for either method of planting.

5. The free use of coal ashes in the drill, which was tried by request, had no observable influence on the development of scab in the present case, although it has been thought by some to favor its development, and others have regarded it as a preventive.

6. The thicker-skinned and red-skinned varieties show no greater resistance to scab than others; our best results this season were from light-skinned and rather delicate, fine-grained sorts. These results conflict with some rather general beliefs, but they are the outcome of experiments carefully planned and carried out, and involve no inherent improbabilities.

The results of extended studies as to the *cause* of potato scab have lately been published by Mr. H. L. Bolley.* He believes it to be due to the action of a *Bacterium* which lives in the soil, and can live parasitically on the potato tuber, causing an irritation which results in the formation of the scab. Mr. Bolley's experiments were well planned and apparently carefully conducted, and his results are of much value. The scab produced by him was apparently the form first called by the writer in the last report of this station the "surface" form. In Bulletin No. 105 of the Connecticut Agricultural Experiment Station, Dr. Roland Thaxter has announced the results of some investigations, in which he had obtained, from potatoes affected by the "deep" form of scab, a vegetable organism of doubtful relationships, which, when sown on growing potatoes, reproduced the same form of the disease in a striking manner.

In our own microscopic study of scabbed potatoes, bacteria were, of course, constantly met with, and fungus threads occasionally, but never under such circumstances as to raise any serious suspicion of their causal relation to the trouble. Had such a suspicion been raised, however, it would have been impossible to have demonstrated the correctness or falsity of the view, since the Department had then

* Agric. Science, September and October, 1890.

neither the necessary accommodations nor equipment for such investigations. At present other equally important studies are in progress, and it does not seem advisable for us to take up the subject, especially since the bacteriological investigations are of a very special nature, and are best conducted by persons who devote their entire attention to that field. It is to be hoped, however, that some European bacteriologist will take up the subject, and repeat the investigations already made in this country; since, as was shown in our last report, the same disease prevails there, at least in its "surface" form, as well as here.

From what has been already said, it is evident that the term "scab," as commonly used, is a general and not a specific one. The rough crusts which give rise to the name are cork formations produced by the growing tuber, in response to, and as an attempted protection against, external irritating influences. That this irritation is sometimes due to parasitic or semi-parasitic organisms seems probable, in the light of the investigations mentioned above; but that it is always so produced is by no means proved, since, in practice, badly diseased tubers have too often given a practically smooth crop. One who insists on the presence of some specific organism as a necessary preliminary to the development of scab must admit a very strong dependence on peculiar conditions on the part of such organism.

It is difficult to believe that the "deep" form of the scab is entirely distinct from the "surface" form, as Dr. Thaxter's results would indicate, although he has found potatoes attacked only by the former near New Haven, Conn., the past season; for both forms have occurred abundantly on potatoes from the same hill on our experimental plots, and not uncommonly both on the same tuber. And the "deep" form has shown, in our experience, such differences in depth as almost to furnish a series running up to the "surface" form; yet it is true that a certain darker and more decayed appearance almost always distinguishes it from the latter.

With regard to the prevention of these troubles, whatever their cause, our recommendation of last year can be repeated with much stronger emphasis. The best land for

potatoes, so far as freedom from scab is concerned, is a light, porous, sandy soil. On such land there may often be raised, year after year, perfectly smooth crops; while on damp, heavy soil, as bad a crop may result the first year as after years of continuous potato culture. At present, then, we can only say that what is termed potato-scab is due to the reaction of one or more of several possible external irritants upon the tubers while they are growing, and that the conditions which least favor its appearance are those afforded by a *light, open, thoroughly drained soil.*

## Notes.

Damping off. — During the past fall, a few cucumber seedlings in the Station greenhouse were killed by the affection known as "damping off," so common and destructive to seedlings in the forcing bench and the hot-bed. The disease, which manifests itself in the decay and consequent falling over of the seedling stem near the level of the surface of the soil, is familiar to most persons who raise plants under glass.

So far as I am aware, the cause of this trouble has not been precisely investigated in this country, though it has been assumed to be caused by the fungus which is known to produce the same effect in Europe, *Pythium de Baryanum* Hesse. The case mentioned afforded an opportunity to ascertain the correctness of this assumption. Examination of the stem of a fallen seedling at the point of attack showed the presence of abundant fungus threads in its disorganized tissues. A piece was placed in a drop of water in a moist chamber, and the threads rapidly extended themselves over the glass slip which held the whole, and in two days had developed the reproductive organs figured in Figs. 21 to 23. These structures agree with those of *P. de Baryanum*, as figured by Hesse, and the fungus is probably the same as that which produces the same results in Europe.

This fungus is closely related to the downy mildews, and reproduces itself by means of zoöspores and by resting spores. Fig. 21 shows two zoösporangia, and in Fig. 23 are seen

some stages in the production of resting spores. Other resting bodies (*gemmæ*) may be formed from the threads in a purely vegetative way (Fig. 22).

The very general distribution of this fungus is indicated by the fact that the soil in which the affected seedlings grew in the present case was, as nearly as possible, virgin soil, having just been brought from a natural woodland, where it had probably been undisturbed for a very long period, into a new greenhouse then first used.

Assuming that "damping off" is always caused by the same fungus, certain directions for its treatment may be given. Plants affected should be at once removed, with the soil immediately surrounding them, and burned. If this is done *as soon as* the seedling falls, the trouble can be held in check, since the fungus will be destroyed before its reproductive organs have developed. When a hot-bed or propagating bench has become so badly infested by the fungus that a large part of the seedlings or cuttings "damp off," the soil should be entirely removed to a distance, and the containing walls thoroughly cleaned and washed with strong whitewash, and refilled with fresh earth. After this treatment, the prompt removal of diseased plants should be sufficient to limit the trouble to an occasional case.

THE MILDEW OF SPINACH (*Peronospora effusa* (Grev.) Rabh.) caused serious damage to that crop on the grounds of the Massachusetts Agricultural College. This fungus is one of the downy mildews, and makes its presence known by the appearance of discolored blotches on the upper surface of the leaf, and corresponding patches of its closely matted spore-bearing threads on the lower surface. Since this crop is cultivated for the leaves, the disease should be controlled by picking and destroying the leaves as fast as they become attacked, and by thorough cleaning of the field as soon as the crop is removed.

Spinach belongs to the same family of plants with some of our common weeds, which are also attacked by this mildew. One of these which appears in almost every field is the so-called pigweed or lamb's quarters (*Chenopodium album*). This plant is equally subject to the attack of the

same fungus; and this fact makes it obvious that spinach fields should be kept scrupulously free from pigweed, which, if allowed to grow, may afford a favorable breeding place for the mildew.

THE GRAPE-VINE MILDEW (*Plasmopara viticola* (B. & C.) Berl. & de T.) might be expected to attack also our native species of *Ampelopsis*, the Virginia Creeper, and the species from Japan, now commonly planted under the name of Japanese or Boston ivy, since the species of *Ampelopsis* are so nearly related to the grapes that they are placed by some writers as a subdivision of the genus *Vitis*, which includes the true grapes. Its occurrence on the Virginia Creeper has been reported from various localities; but, so far as I know, the Japanese ivy (*A. Veitchii*) has been only once reported as its host.* It is therefore worth while to note the occurrence of the mildew on the latter plant, in October last, in Amherst. The fungus was well developed, almost as luxuriant as on the grape, and its summer spores, always varying considerably in size, showed an unusually wide range of dimension. The leaves attacked were large and strong, and the fungus threads penetrated their tissues very thoroughly, though a careful examination failed to discover the resting spores. The damage to the vines, which were well established and vigorous, was not important, and the chief interest of the facts noted lies in the possible danger to grape vines in the proximity of wild or cultivated *Ampelopsis* plants, which may serve as an important source of infection, if their presence is overlooked. The simplest precaution is, naturally, that of rigorously excluding the species named from the neighborhood of grape vines.

Two closely related fungi appeared to a considerable extent on a plot of purple-topped white turnips on the Station grounds in September last. They were the DOWNY MILDEW (*Peronospora parasitica* (P.) Tul.) and the WHITE RUST (*Cystopus candidus* (Pers.) Lev.) of *cruciferous* plants. They often appear together, and sometimes do considerable damage. Any field on which they

* Journal of Mycology, 1889, p. 202.

have appeared, and on which it is intended to plant turnips, cabbages, radishes, or any cruciferous crop, the next year, should be carefully cleaned of all refuse, leaves, etc., as soon as the crop is harvested; since these fungi winter over by means of resting spores developed in the leaves and stems, and set free by their decay.

Late potatoes have been an almost total loss throughout the State, on account of the attacks of the POTATO-ROT fungus (*Phytophthora infestans* (Mont.) de By.). As the weather early in the season was not especially favorable to the development of the fungus, early potatoes were, as a rule, harvested in excellent condition; but a period of warm, moist weather in September was fatal to the late crop. A few complaints of rotting were received early in the season, but whenever specimens were sent they showed no fungus, but merely a browning and shrivelling, due probably to the rather severe drought prevailing at the time. In accordance with a request, the following brief account of the characteristic appearance of leaves attacked by the rot fungus is here given. The spots, at first yellow, soon become of a dark-brown or blackish, muddy color, quite different from the clearer and lighter brown of merely dried leaves. Another peculiarity of these spots is their soft, rotten condition, very different from that produced by drying up, or by most other fungi. Around the edges of the dark spots may usually be observed, on close examination, especially with a hand magnifier, and chiefly on the lower side of the leaf, a delicate white "fuzz," composed of the spore-bearing threads of the fungus. The disease usually appears first at some part of a field, and thence spreads, frequently in a definite direction, with the prevailing wind.

Only the promptest action can save a field where the fungus has begun to spread; but it has been repeatedly shown that the sufficiently prompt and frequent application to the plants of the Bordeaux mixture, the materials for which must be kept on hand, will avert a very large part of the threatened loss.

THE ELDER RUST (*Æcidium Sambuci* Schw.) has been very abundant during the past season on our common elder

(*Sambucus Canadensis*), and its cultivated variety *aurea*, and was sent from Brookline by W. H. Manning, Esq., who reported it as greatly disfiguring the ornamental cut-leaved black elder (*S. nigra*, var. *laciniata*). It occurs on the leaf blades and stalks, where it causes the normal tissue to become greatly overdeveloped, producing large, fleshy masses, which distort the leaf and bear the spore cups on their surfaces.

The fungus is one which is difficult to deal with, as so little is known of its life history. It is the *cluster-cup* stage of one of the rust fungi, and none of the other stages has been found on the elder. It is probable that these occur on some other host plant; but, until the connection is established, little can be done to prevent its attacks, except to remove the affected foliage and burn it. The fact of the prevalence of the fungus in one season, however, does not prevent its being very rare in the next; and the controlling conditions are, as yet, very little understood.

THE RUST OF BLACKBERRIES AND RASPBERRIES (*Cæoma nitens* Schw.) is one of the commonest and most striking of our fungi. It produces at first a stunted and yellowish appearance of the shoots attacked, which is soon followed by the development of the spores in brilliant orange patches, almost or quite covering the lower surfaces of the leaves.

Experiments point to the probability that its spread by means of its spores can be checked by spraying with the Bordeaux mixture; but when a plant is once attacked there is no alternative but to dig it up and burn it, since the vegetative threads of the fungus live through the winter in the stalks, and thence penetrate the new shoots and leaves in the spring, developing the spores on the leaves. The spores are summer spores and have not yet been proved to be connected with any resting-spore form, but it is not improbable that such a connection may yet be traced; though its ability to hibernate in the host plant makes it possible that we have to deal with an independent form.

THE HOLLYHOCK RUST (*Puccinia Malvaccarum* Mont.) has become, within a few years, an important disease in Massachusetts. It is a native of Chili, whence it was intro-

duced into Europe some years ago. In 1885 it was brought to this country with some imported *Malope* planted at Beverly Farms, Mass., and spread to the hollyhocks there in 1886. From this point, or possibly from other points as well, it extended, appearing in Boston, Cambridge, Nahant and elsewhere, and has been recently observed in central New York. It was forwarded this year to the station by G. L. Lovett, Esq., of West Newton.

The spores have the structure of the resting spores of the rusts, but are not resting spores, since they germinate at once, and infect new plants. Perhaps the last spores of the season are resting spores, by which the fungus survives the winter, as has been shown to be the case with some similar species. Affected plants should be promptly removed and destroyed, if it is desired to protect those still unharmed.

Disease of Oats. — The Massachusetts Crop Report for June, 1890, contained numerous complaints, especially from the western counties, of the failure of oats from "rusting;" and the October Report mentions oats among the crops which generally failed throughout the State. Letters to the Crop Report correspondents in Barre, Deerfield and Ludlow brought replies and specimens of the affected oats, for which the gentlemen named have the thanks of this Department. In every case the plants had a general brown or "rusty" color, but their appearance was quite different from that of plants attacked by the grain-rust fungi (*Puccinia graminis* Pers., *P. coronata* Cda., etc.). No fungus or animal could be detected in any part of the plant, but Bacteria were always present. Other work prevented any detailed study of the trouble; but there is no reason to doubt that it is the same which was very generally reported from the Eastern and Central States, and which materially reduced the oat crops of those sections. This disease has been investigated by the Division of Vegetable Pathology of the United States Department of Agriculture, and is regarded as caused by a specific Bacterium.* Until our knowledge of it is much more com-

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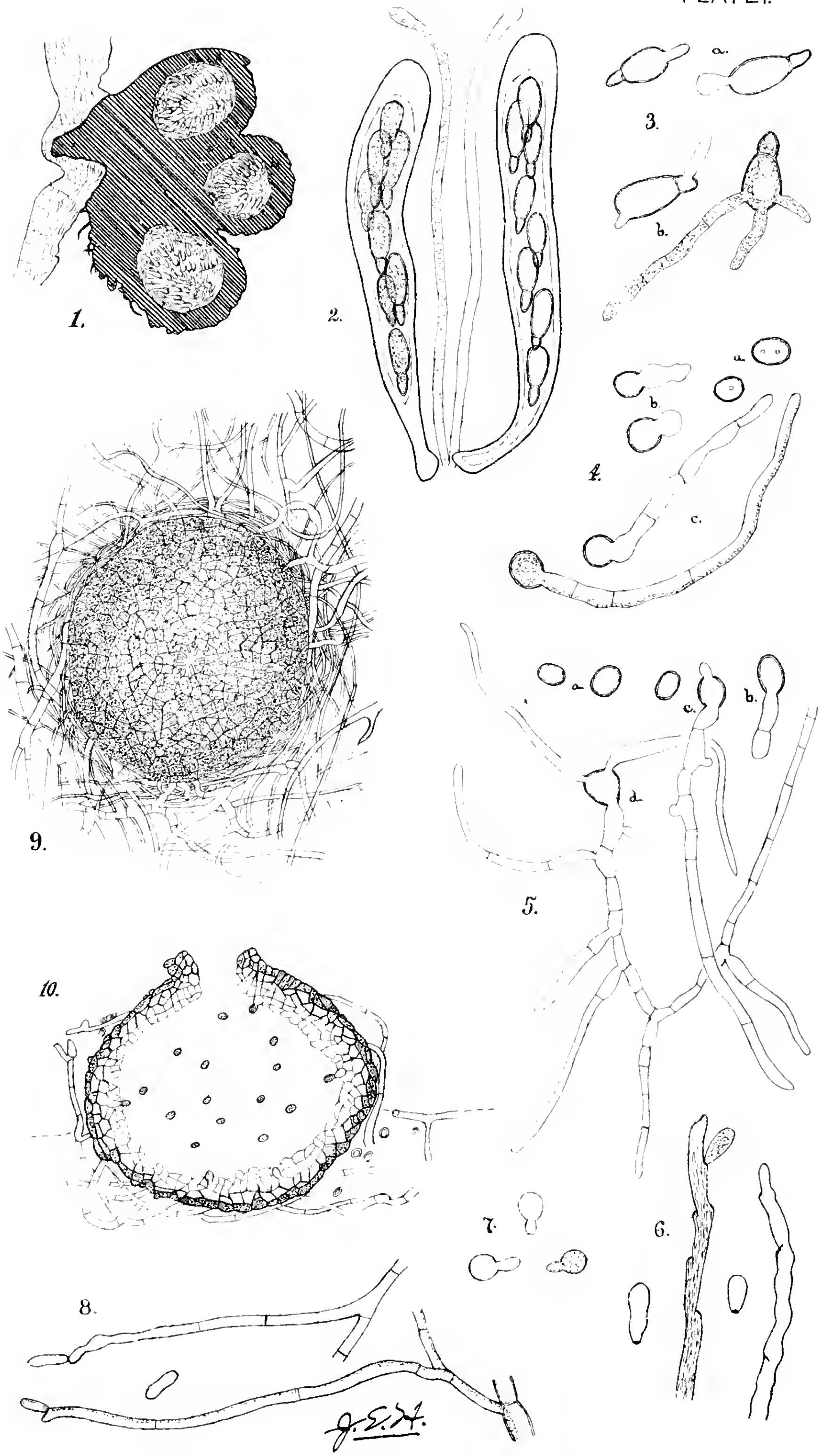
* Journal of Mycology, 1890, p. 72.

plete, no recommendations concerning treatment can be made; and, indeed, it is by no means improbable that it may prove to be so dependent upon meteorological and other conditions as not to occur again for a long period, as has been suggested.

## Note on Fungicides.

Formulæ for some of the most useful fungicides were given in our last report, at page 212. The materials for the preparation of these and others, together with an effective spraying pump, were purchased by the station last spring, in the expectation that we should be able to test them on crops on the station plots during the season. No fungous disease appeared on any crop, however, to such a degree as to render any test of fungicides possible, and the outfit and materials remain in our hands for use next season, should circumstances favor. Full directions for preparing and applying such fungicides as the latest experience has shown to be most valuable will be given in a bulletin of this station early next spring.

PLATE I.



# EXPLANATION OF PLATE I.

*The Fungus of Black Knot.* (*Plowrightia Morbosa* (Sz.) Sacc.)

Fig. 1. Diagrammatic representation of a section through three perithecia containing spore sacs (*asci*). x 72.*

Fig. 2. Two sacs containing ripe spores, and two sterile threads (*paraphyses*). x 940.

Fig. 3. Four winter spores (*ascospores*), germinating in water; *a*, after one day; *b*, after two days. x 940.

Fig. 4. Six *pycnospores* from a knot; *a*, just placed in water; *b*, after one day; *c*, after two days in water. x 940.

Fig. 5. Six *pycnospores* from a *pycnidium* developed on gelatine from winter spores; *a*, three fresh spores; *b*, a spore after one day in water; *c*, a spore after two days in water; *d*, a spore after two days on nutrient gelatine. *d* x 540; others x 940.

Fig. 6. Three summer spores (*conidia*), with two of the threads on which they are borne. x 940.

Fig. 7. Three summer spores beginning to germinate after one day on nutrient gelatine. x 940.

Fig. 8. Threads bearing new crop of summer spores produced on gelatine culture of summer spores from young knot, shown in Figs. 6 and 7. x 540.

Fig. 9. Surface view, from above, of a *pycnidium* developed on gelatine from winter spores. x 350.

Fig. 10. Vertical section through such a *pycnidium*, showing origin of spores. x 350.

Drawn chiefly from a single section, but completed in some details from others. The threads about the mouth are not shown in the section.

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* The number given after each figure represents the degree of magnification of the original drawing, which has been reduced about one-third in this plate. The magnification of the figures, as here given, is therefore about two-thirds of that indicated by the printed numbers.

# EXPLANATION OF PLATE II.

*The Cucumber Mildew.* (*Plasmopara Cubensis*) (B. & C.)

Fig. 11. A conidial thread arising from a vegetative thread; *sp.*, two summer spores (*conidia*). x 540.*

Fig. 12. A portion of a vegetative thread giving rise to two conidial threads through the same leaf-pore. x 540.

Fig. 13. A young conidial thread with the spores not yet fully developed and still in place. x 540.

Fig. 14. A portion of a vegetative thread among the cells of a leaf, four of which are shown, and penetrating them by its *haustoria*, *h*. x 540.

*The Mildew of the Star Cucumber.* (*Plasmopara australis* Spag.)

Fig. 15. A conidial thread and spores; *a* x 350 ; *sp.* spores x 540.

Fig. 16. A portion of a vegetative thread, with *haustoria*, *h*. x 540.

*The Brown Rot of Stone Fruits.* (*Monilia fructigena* Pers.)

Fig. 17. Spore chains. x 540.

Fig. 18. End of a growing chain, showing beginnings of new spores and origin of branching. x 540.

Fig. 19. Threads terminating in spore chains, developed in five days from spores sown on nutrient gelatine. x 200.

Fig. 20. Threads, *a*, and resting cells (*Gemmæ*), *b*, from the flesh of "mummied" plums, in winter. x 540.

*The "Damping-off" Fungus.* (*Pythium de Baryanum* Hesse.)

Fig. 21. Two *zoösporangia*, showing beginnings in formation of *zoöspores*. x 540.

Fig. 22. A resting cell (*Gemma*). x 540.

Fig. 23. Sexual organs; *a*, female cell (*oögonium*), with a single male (*antheridium*) ; *b*, with two males ; *c*, resting spore (*oöspore*), formed and fertilized as shown by emptying of male cell. x 540.

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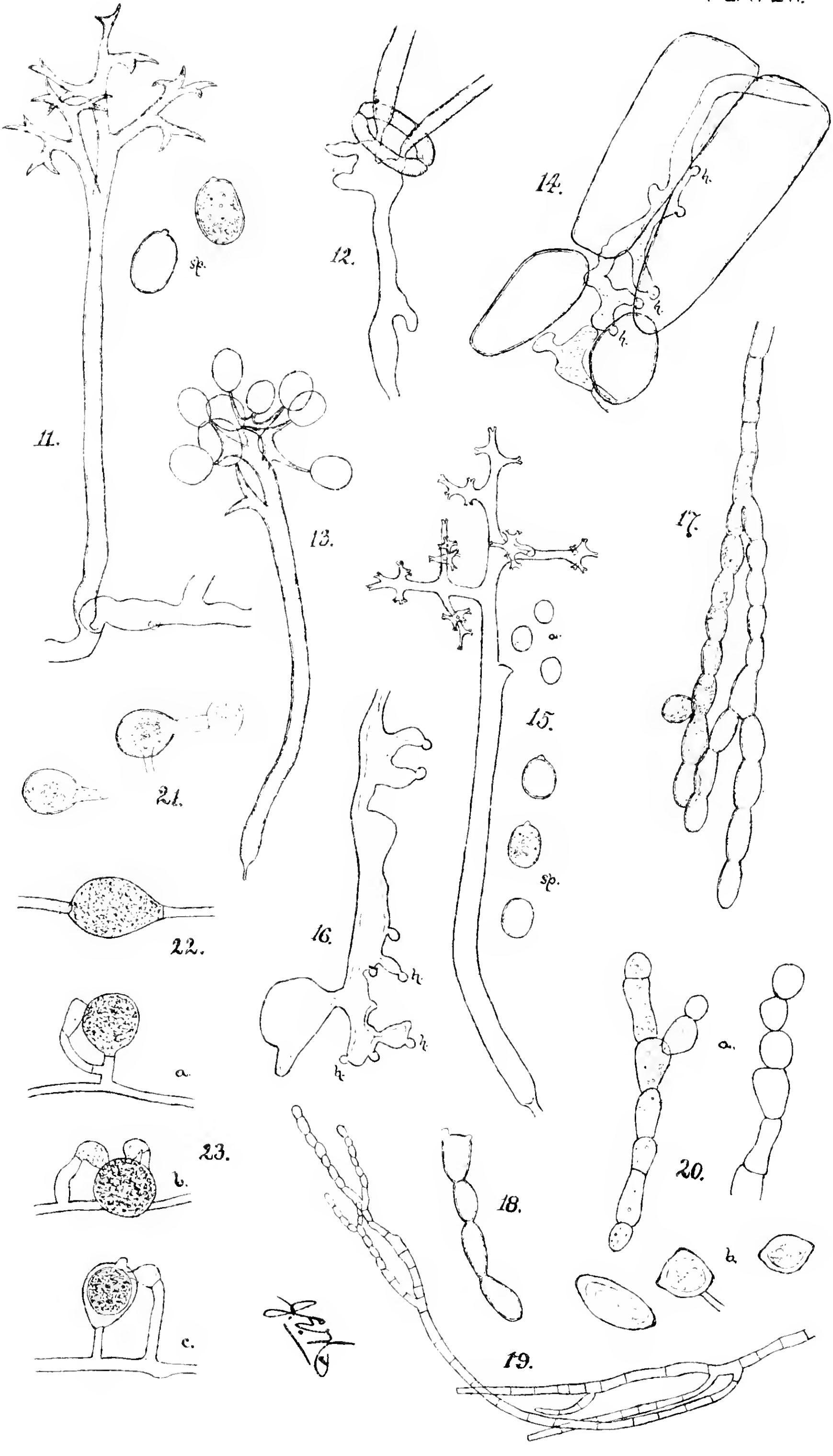
* See note to Plate I.

# PLATE II.



# SPECIAL WORK IN THE CHEMICAL LABORATORY.

I. Communication on commercial fertilizers : —

1. General introduction.
2. Laws for the regulation of the trade in commercial fertilizers.
3. List of licensed manufacturers for May 1, 1889, to May 1, 1890.
4. Analyses of licensed fertilizers.
5. Analyses of commercial fertilizers and manurial substances sent on for examination.
6. Miscellaneous analyses.

II. Water analyses.

III. Compilation of analyses made at Amherst, Mass., of agricultural chemicals and refuse materials used for fertilizing purposes.

IV. Compilation of analyses made at Amherst, Mass., of fodder articles, fruits, sugar-producing plants, dairy products, etc.

## I. Communication on Commercial Fertilizers.

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### *1. General Introduction.*

The trade in commercial fertilizers has been quite active in our State during the past year. Fifty-one manufacturers and dealers in manurial substances have applied for and received certificates for their compliance with our State laws for the regulation of the trade in commercial fertilizers; twenty-nine of these are residing in the State, while twenty-two are residents of other States.

One hundred and fifty-eight samples of licensed articles of various description have been collected in all parts of the State by a duly authorized agent of the station. They were analyzed at the chemical laboratory of the latter, with the following results: fifty-four samples contained one single essential constituent below the lowest guaranty; ten samples contained two essential constituents below the lowest guaranty; three samples contained all three essential constituents below the lowest guaranty; fifty-six samples contained one essential constituent above the highest guaranty; thirteen samples contained two essential constituents above the highest guaranty; four samples contained all three essential constituents above the highest guaranty. The deficiency in regard to one or two essential constituents was in the majority of cases commercially compensated by the excess of another one.

The fluctuation in the market price of most standard articles used in the manufacture of compound fertilizers has been within the usual limits during the past season. Tankage, nitrate of soda, blood, azotin and sulphate of

potash declined during the middle of May. Bones, refuse bone-black and crude phosphate rock have remained unchanged in price since January 1. Muriate of potash and kainite held their own, while sulphate of ammonia advanced somewhat. Judging from present indications, some changes regarding the cost of commercial fertilizers may be expected for the coming season.

The duties assigned to the director of the station, to act as inspector of commercial fertilizers, render it necessary to discriminate, in official publications of the results of analyses of commercial fertilizers and of manurial substances in general made at the station, between analyses of samples collected by a duly qualified delegate of the experiment station, in conformity with the rules prescribed by the new laws, and those analyses which are made of samples sent on for that purpose by outside parties. In regard to the former alone can the director assume the responsibility of a carefully prepared sample, and of the identity of the article in question.

The official report of analyses of compound fertilizers and of all such materials as are to be used for manurial purposes, which are sold in this State under a certificate of compliance with the present laws for the regulation of the trade in these articles, has been restricted by our State laws to a statement of chemical composition, and to such additional information as relates to the latter. The practice of affixing to each analysis of this class of fertilizers an approximate commercial valuation per ton of their principal constituents has, therefore, been discontinued. This change, it is expected, will tend to direct the attention of the consumers of fertilizers more forcibly towards a consideration of the particular composition of the different brands of fertilizers offered for their patronage, — a circumstance not unfrequently overlooked.

The approximate market value of the different brands of fertilizers, obtained by the current mode of valuation, does not express their respective agricultural value, *i.e.*, their crop-producing value; for the higher or lower market price of different brands of fertilizers does not necessarily stand in a direct relation to their particular fitness, without

any reference to the particular condition of the soil to be treated, and the special wants of the crops to be raised by their assistance. To select judiciously, from among the various brands of fertilizers offered for patronage, requires, in the main, two kinds of information; namely, we ought to feel confident that the particular brand of fertilizer in question actually contains the guaranteed quantities and qualities of essential articles of plant food at a reasonable cost, and that it contains them in such form and such proportions as will best meet existing circumstances and special wants. In some cases it may be mainly either phosphoric acid or nitrogen or potash; in others, two of them; and in others again, all three.

A remunerative use of commercial fertilizers can only be secured by attending carefully to the above-stated considerations.

To assist farmers not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for their commercial valuation, are once more stated within a few subsequent pages.

The hitherto customary valuation of manurial substances is based on the average trade value of the essential fertilizing elements specified by analysis. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends in the majority of cases on the amount and the particular form of two or three essential articles of plant food — *i.e.*, phosphoric acid, nitrogen and potash — which they contain. To ascertain, by this mode of valuation, the approximate market value of a fertilizer (*i.e.*, the money worth of its essential fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound; the same course is adopted with reference to the various forms of phosphoric acid and of potassium oxide. We thus get the values per ton of the several ingredients, and, adding them together, we obtain the total valuation per ton in case of cash payments at points of general distribution.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barn-yard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to the market value of the amount of essential articles of plant food they contain. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value in case of one and the same kind of substance. Two samples of fish fertilizers, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse materials of various descriptions, have to be valued with reference to the market price of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

*Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.*

| | 1890. Cents per Pound. |
|---|---|
| Nitrogen in ammoniates, | 17 |
| Nitrogen in nitrates, | 14½ |
| Organic nitrogen in dry and fine ground fish, meat, blood, | 17 |
| Organic nitrogen in cotton-seed meal and castor pomace, | 15 |
| Organic nitrogen in fine ground bone and tankage, | 16½ |
| Organic nitrogen in fine-ground medium bone and tankage, | 13 |
| Organic nitrogen in medium bone and tankage, | 10½ |

*Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals* — Concluded.

| | 1890. Cents per Pound. |
|---|---|
| Organic nitrogen in coarser bone and tankage, | $8\frac{1}{2}$ |
| Organic nitrogen in hair, horn-shavings and coarse fish scraps, | 8 |
| Phosphoric acid soluble in water, | 8 |
| Phosphoric acid soluble in ammonium citrate, | $7\frac{1}{2}$ |
| Phosphoric acid in dry ground fish, fine bone and tankage, | 7 |
| Phosphoric acid in fine medium bone and tankage, | 6 |
| Phosphoric acid in medium bone and tankage, | 5 |
| Phosphoric acid in coarse bone and tankage, | 4 |
| Phosphoric acid in fine-ground rock phosphate, | 2 |
| Potash as high-grade sulphate, and in forms free from muriate or chlorides, ashes, etc.. | 6 |
| Potash as kainite, | $4\frac{1}{2}$ |
| Potash as muriate, | $4\frac{1}{2}$ |

The organic nitrogen in superphosphates, special manures and mixed fertilizers of a high grade, is usually valued at the highest figures laid down in the trade values of fertilizing ingredients in raw materials, namely,, seventeen cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones, or other equally good forms, and not from leather shoddy, hair, or any low-priced, inferior form of vegetable matter, unless the contrary is ascertained. For similar reason, the insoluble phosphoric acid is valued in this connection at three cents, it being assumed, unless found otherwise, that it is from bone or similar sources, and not from rock phosphate. In this latter form the phosphoric acid is worth but two cents per pound.

The above trade values are figures at which, in the six months preceding March, 1890, the respective ingredients could be bought at retail for cash in our large markets, in the raw materials, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1, plus about twenty per cent. in case of goods for which we have wholesale quotations. The valuations obtained by use of the above figures will be found to agree fairly with the retail price at the large markets of standard raw materials, such as: —

| | |
|---|---|
| Sulphate of ammonia, | Dry ground fish, |
| Nitrate of soda, | Azotin, |
| Muriate of potash, | Ammonite, |
| Sulphate of potash, | Castor pomace, |
| Dried blood, | Bone and tankage, |
| Dried ground meat, | Plain superphosphates. |

A large percentage of commercial materials consists of refuse matter from various industries. The composition of these substances depends upon the mode of manufacture carried on. The rapid progress in our manufacturing industries is liable to affect, at any time, more or less seriously, the composition of the refuse. To assist the farming community in a clear and intelligent appreciation of the various substances sold for manurial purposes, a frequent examination into the temporary characters of agricultural chemicals and refuse materials offered in our markets for manurial purposes is constantly carried on at the laboratory of the station.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guarantee of composition with reference to their essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. A mistake or misunderstanding may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding, in its composition, with the lowest stated quantity of each specified essential constituent. Our present laws for the regulation of the trade in commercial fertilizers include not only the various brands of compound fertilizers, but also all materials, single or compound, without reference to source, used for manurial purposes, when offered for sale on our market at ten dollars or more per ton.

Copies of our present laws for the regulation of the trade in commercial fertilizers may be had by all interested, on application at the Massachusetts State Agricultural Experiment Station, Amherst, Mass.

## 2. *Laws for the Regulation of the Trade in Commercial Fertilizers.*

[CHAP. 296.]

AN ACT TO REGULATE THE SALE OF COMMERCIAL FERTILIZERS

*Be it enacted, etc., as follows:*

SECTION 1. Every lot or parcel of commercial fertilizer or material used for manurial purposes sold, offered or exposed for sale within this Commonwealth, the retail price of which is ten dollars or more per ton, shall be accompanied by a plainly printed statement clearly and truly certifying the number of net pounds of fertilizer in the package, the name, brand, or trade-mark under which the fertilizer is sold, the name and address of the manufacturer or importer, the place of manufacture, and a chemical analysis stating the percentage of nitrogen or its equivalent in ammonia, of potash soluble in distilled water, and of phosphoric acid in available form soluble in distilled water and reverted, as well as the total phosphoric acid. In the case of those fertilizers which consist of other and cheaper materials, said label shall give a correct general statement of the composition and ingredients of the fertilizer it accompanies.

SECT. 2. Before any commercial fertilizer, the retail price of which is ten dollars or more per ton, is sold, offered or exposed for sale, the importer, manufacturer or party who causes it to be sold or offered for sale within the state of Massachusetts, shall file with the director of the Massachusetts agricultural experiment station, a certified copy of the statement named in section one of this act, and shall also deposit with said director at his request a sealed glass jar or bottle, containing not less than one pound of the fertilizer, accompanied by an affidavit that it is a fair average sample thereof.

SECT. 3. The manufacturer, importer, agent or seller of any brand of commercial fertilizer or material used for manurial purposes, the retail price of which is ten dollars or more per ton, shall pay for each brand, on or before the first day of May annually, to the director of the Massachusetts agricultural experiment station, an analysis fee of five dollars for each of the three following fertilizing inredients: namely, nitrogen, phosphorus, and potassium, contained or claimed to exist in said brand or fertilizer: *provided*, that whenever the manufacturer or importer shall have paid the fee herein required for any person acting as agent or seller for such manufacturer or importer, such agent or seller shall not be required to pay the fee named in this section: and on receipt of said analysis fees and statement specified in section two, the

director of said station shall issue certificates of compliance with this act.

SECT. 4. No person shall sell, offer or expose for sale in the state of Massachusetts, any pulverized leather, raw, steamed, roasted, or in any form as a fertilizer, or as an ingredient of any fertilizer or manure, without an explicit printed certificate of the fact, said certificate to be conspicuously affixed to every package of such fertilizer or manure and to accompany or go with every parcel or lot of the same.

SECT. 5. Any person selling, offering or exposing for sale, any commercial fertilizer without the statement required by the first section of this act, or with a label stating that said fertilizer contains a larger percentage of any one or more of the constituents mentioned in said section than is contained therein, or respecting the sale of which all the provisions of the foregoing section have not been fully complied with, shall forfeit fifty dollars for the first offence, and one hundred dollars for each subsequent offence.

SECT. 6. This act shall not affect parties manufacturing, importing or purchasing fertilizers for their own use, and not to sell in this state.

SECT. 7. The director of the Massachusetts agricultural experiment station shall pay the analysis fees, as soon as received by him, into the treasury of the station, and shall cause one analysis or more of each fertilizer or material used for manurial purposes to be made annually, and publish the results monthly, with such additional information as circumstances advise: *provided*, such information relate only to the composition of the fertilizer or fertilizing material inspected. Said director is hereby authorized in person or by deputy to take a sample, not exceeding two pounds in weight, for analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer; but said sample shall be drawn in the presence of said party or parties in interest or their representative, and taken from a parcel or a number of packages which shall be not less than ten per cent. of the whole lot inspected, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the director or his deputy and by the party or parties in interest or their representatives present at the drawing and sealing of said sample; one of said duplicate samples shall be retained by the director and the

other by the party whose stock was sampled. All parties violating this act shall be prosecuted by the director of said station; but it shall be the duty of said director, upon ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of the fertilizer or fertilizing material if the same shall be found substantially equivalent to the statement of analysis made by the manufacturer or importer.

SECT. 8. Sections eleven to sixteen inclusive of chapter sixty of the Public Statutes are hereby repealed.

SECT. 9. This act shall take effect on the first day of September in the year eighteen hundred and eighty-eight. [*Approved May 3, 1888.*]

*Instructions issued, at the Beginning of the Season, to Dealers in Commercial Fertilizers.*

1. An application for a certificate of compliance with the regulations of the trade in commercial fertilizers and materials used for manurial purposes in this State must be accompanied: —

*First*, with a distinct statement of the name of each brand offered for sale.

*Second*, with a statement of the amount of phosphoric acid, of nitrogen and of potassium oxide guaranteed in each distinct brand.

*Third*, with the fee charged by the State for a certificate, which is five dollars for each of the following articles: nitrogen, phosphoric acid and potassium oxide guaranteed in any distinct brand.

2. The obligation to secure a certificate applies not only to compound fertilizers, but to all substances, single or compound, used for manurial purposes, and offered for sale at ten dollars or more per ton of two thousand pounds.

3. The certificate must be secured annually before the 1st of May.

4. Manufacturers, importers and dealers in commercial fertilizers can appoint in this State as many agents as they desire, after having secured at this office the certificate of compliance with our laws.

5. Agents of manufacturers, importers and dealers in commercial fertilizers are held personally responsible for their transactions, until they can prove that the articles they offer for sale are duly recorded in this office.

6. Manufacturers and importers are requested to furnish a list of their agents.

7. All applications for certificates ought to be addressed to the Director of the Massachusetts State Agricultural Experiment Station.

### 3. *List of Dealers who have secured Certificates for the Sale of Commercial Fertilizers in This State during the Past Year, and the Brands licensed by Each.*

E. Frank Coe, New York, N. Y. : —
- High-grade Ammoniated Bone Superphosphate.
- Fish and Potash.
- Potato Fertilizer.
- Gold Brand Excelsior Guano.

Standard Fertilizer Company, Boston, Mass. : —
- Standard Fertilizer.
- Standard Superphosphate.

H. S. Miller & Co., Newark, N. J. : —
- Standard Superphosphate of Lime.
- Ammoniated Dissolved Bone Phosphate.
- Potato Fertilizer.
- Ground Bone.

J. E. Soper & Co., Boston, Mass. : —
- Cotton-seed Hull Ashes.

Leander Wilcox, Mystic Bridge, Conn. : —
- Dry Ground Fish Guano.
- Acidulated Fish Guano.

J. M. Butman, Lowell, Mass. : —
- Lowell Bone Fertilizer.

J. S. Reese & Co. Baltimore, Md., licensees of Clark's Cove Guano Company, New Bedford, Mass. : —
- Bay State Fertilizer.
- Concentrated Manure for Corn and Potatoes.
- King Philip Alkaline Guano.
- Great Planet A. A. Manure.
- Fish and Potash.
- New England Favorite.
- Pilgrim Fertilizer.

E. H. Smith, Northborough, Mass. : —
- Steamed Bone.

Whittemore Bros., Wayland, Mass. : —
- Whittemore's Complete Manure.

Ames Fertilizer Company, Peabody, Mass. : —
- Ames' Bone Fertilizer.

G. E. Holmes, Worcester, Mass. : —
- Steamed Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

J. C. Dow & Co., Boston, Mass.: —
- Nitrogenous Superphosphate.
- Ground Bone Fertilizer.
- Fine-ground Bone.

N. Ward Company, Boston, Mass.: —
- High-grade Animal Fertilizer.

Hargrave Manufacturing Company, Fall River, Mass.: —
- Steamed Bone.

Bradley Fertilizer Company, Boston, Mass.: —
- XL Phosphate.
- B. D. Sea-fowl Guano.
- Coe's Original Superphosphate of Lime.
- Fish and Potash.
- Pure Fine-ground Bone.
- Bradley's Complete Manures: —
  - For Potatoes and Vegetables.
  - For Corn and Grain.
  - For Top-dressing Grass and Grain.
- Bradley's Grass Manure for Top-dressing.
- Bradley's Potato Manure.
- Nitrate of Soda.
- Sulphate of Ammonia.
- Muriate of Potash.
- Dissolved Bone-black.

A. Lee & Co., Boston, Mass.: —
- Lawrence Fertilizer.
- Ground Bone.

Lister's Agricultural Chemical Works, Newark, N. J.: —
- Standard Superphosphate of Lime.
- Ammoniated Dissolved Bone.

W. D. Stewart & Co., Boston, Mass.: —
- Soluble Pacific Guano.

Cleveland Dryer Company, Boston, Mass.: —
- Cleveland Potato Phosphate.
- Cleveland Superphosphate.

Cumberland Bone Company, Portland, Me.: —
- Cumberland Superphosphate.
- Seeding-down Fertilizer.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Read Fertilizer Company, Syracuse, N. Y.: —
- Farmers' Friend.
- Lion Brand.
- High-grade Farmers' Friend Special.
- Sampson Brand, or Lion Special.

W. J. Brightman & Co., Tiverton, R. I.: —
- Fish and Potash.
- Superphosphate.
- Dry Ground Fish.

Adams & Thomas, Springfield, Mass.: —
- Adams' Market Bone Fertilizer.

L. B. Darling Fertilizer Company, Pawtucket, R. I.: —
- Darling's Animal Fertilizer.
- Extra Bone Phosphate.
- Potato and Root-crop Manure.
- Pure Bone.
- Muriate of Potash.
- Sulphate of Potash.

Joseph Church & Co., Tiverton, R. I.: —
- Fish and Potash.
- Church's Special.
- Church's Standard.
- Dried and Ground Fish.

F. C. Sturtevant, Hartford, Conn.: —
- Tobacco and Sulphur Fertilizer.

Edmund Hersey, Hingham, Mass.: —
- Steamed Bone.

Forest City Wood Ash Company, London, Ontario: —
- Unleached Wood Ashes.

C. E. Mayo & Co., Boston, Mass.: —
- Mayo's Superphosphate.

Great Eastern Fertilizer Company, Rutland, Vt.: —
- Great Eastern General, for Grain and Grass.
- Great Eastern Vegetable, Vine and Tobacco Fertilizers.
- Great Eastern General, Oats, Buckwheat and Seeding-down Phosphate.

Sandford Winter, Brockton, Mass.: —
- Steamed Bone.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

Prentiss, Brooks & Co., Holyoke, Mass. : —
- Dry Fish.
- Dissolved Bone-black.
- Muriate of Potash.
- Nitrate of Soda.
- Sulphate of Potash.

Mapes Formula and Peruvian Guano Company, New York, N. Y. : —
- The Mapes Bone Manures.
- Peruvian Guano.
- Mapes Superphosphate.
- Mapes Special Crop Manures.

Bowker Fertilizer Company, Boston, Mass. : —
- Stockbridge Manures.
- Hill and Drill Phosphate.
- Lawn and Garden Fertilizer.
- Ammoniated Bone Fertilizer.
- Fish and Potash.
- Dry Ground Fish.
- Gloucester Fish and Potash.
- Fine-ground Bone.
- Plain Superphosphate.
- Kainite.
- Nitrate of Soda.
- Dried Blood.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulphate of Potash.

C. A. Bartlett, Worcester, Mass. : —
- Pure Ground Bone.
- Animal Fertilizer.

W. E. Fyfe & Co., Clinton, Mass. : —
- Unleached Wood Ashes.

Quinnipiac Fertilizer Company, New London, Conn. : —
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Dry Ground Fish.
- Quinnipiac Fish and Potash.
- Muriate of Potash.
- Sulphate of Potash.

3. *List of Dealers who have secured Certificates, etc.* — Continued.

John G. Jefferds, Worcester, Mass. : —
Jefferds' Animal Fertilizer.
Jefferds' Fine-ground Bone.

Crocker Fertilizer and Chemical Company, Buffalo, N. Y. : —
New Rival Ammoniated Superphosphate.
Buffalo Superphosphate, No. 2.
Special Potato Manure.
Pure Ground Bone.
Ammoniated Bone Superphosphate.
Potato, Hop and Tobacco Phosphate.
Queen City Phosphate.
Vegetable Bone Superphosphate.
Ammoniated Wheat and Corn Phosphate.

James E. McGovern, Lawrence, Mass. : —
West Andover Market Bone Phosphate.
Fine-ground Bone.

American Manufacturing Company, Boston, Mass. : —
The Allen Fertilizer.

Thomas Hersom & Co., New Bedford, Mass. : —
Fine-ground Bone.
Meat and Bone.

H. J. Baker & Bro., New York, N. Y. : —
A. A. Ammoniated Superphosphate.
Pelican Bone Fertilizer.
Potato Manure.

Munroe, Judson and Stroup, Oswego, N. Y. : —
Unleached Wood Ashes.

The Geo. W. Miles Fertilizer and Oil Company, Milford, Conn. : —
IXL Ammoniated Bone Superphosphate.
Fish and Potash.

Joseph Breck & Son, Boston, Mass. : —
Breck's Lawn and Garden Dressing.

National Fertilizer Company, Bridgeport, Conn. : —
Chittenden's Complete Fertilizer.
Chittenden's Fish and Potash.
Chittenden's Universal Phosphate.
Ground Bone.

Stearns' Fertilizer Company, New York, N. Y. : —
Ammoniated Bone Superphosphate.
American Guano.

3. *List of Dealers who have secured Certificates, etc.* — Concluded.

Davidge Fertilizer Company, New York, N. Y.: —
- Potato Manure.
- Vegetator.
- Special Favorite.

The Le Page Company, Boston, Mass.: —
- Red Star Brand 203 Fertilizer.
- Red Star Brand Special Potato Fertilizer.

William Lavery, Amesbury, Mass.: —
- Lavery's Superphosphate.
- Steamed Bone.

4. *Analyses of Commercial Fertilizers collected during the Past Season in the General Markets by the Agent of the Massachusetts Agricultural Experiment Station.*

| Laboratory Number. | Name of Brand. | Name of Manufacturer. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 1 | Tuttle's Fish, | Prentiss, Brooks & Co., Holyoke, Mass., | Hatfield. |
| 3 | Whittemore's Complete Manure, | Whittemore Bros., Wayland, Mass., | Wayland. |
| 4 | Lowell Bone Fertilizer, | J. M. Butman, Chelmsford, Mass., | Chelmsford. |
| 8 | Potato Manure, | H. J. Baker & Bro., New York, N. Y., | Boston. |
| 14 | Hill and Drill Phosphate, | Bowker Fertilizer Company, Boston, Mass., | North Sudbury. |
| 19 | Fish and Potash, | Joseph Church & Co , Tiverton, R. I., | Springfield. |
| 25 | Adams' Market Bone Fertilizer, | Adams & Thomas, Springfield, Mass., | Springfield. |
| 37 | Vegetable, Vine and Tobacco Fertilizer, | Great Eastern Fertilizer Company, Rutland, Vt., | Framingham. |
| 39 | Potato and Root Crop Manure, | L. B. Darling Fertilizer Company, Pawtucket, R. I., | North Framingham. |
| 41 | Original Bay State Bone Superphosphate, | J. A. Tucker & Co., Boston, Mass., | Framingham. |
| 44 | Ammoniated Bone Superphosphate, | National Fertilizer Company, Bridgeport, Conn., | Northborough. |
| 54 | Darling's Pure Dissolved Bone, | L. B. Darling Fertilizer Company, Pawtucket, R. I., | Lawrence. |
| 67 | Wilcox's Dry Ground Fish Guano, | Leander Wilcox, Mystic Bridge, Conn., | Amherst. |
| 77 | Quinnipiac Dry Ground Fish, | The Quinnipiac Company, New London, Conn., | Northampton. |
| | *Bones.* | | |
| 2 | Steamed Bone, | E. H. Smith, Northborough, Mass., | Northborough. |
| 5 | Bone Flour, | H. S. Miller & Co., Newark, N. J., | Boston. |
| 6 | Ground Bone, | H. S. Miller & Co., Newark, N. J., | Boston. |
| 16 | Steamed Bone, | J. G. Jefferds, Worcester, Mass., | Worcester. |
| 17 | Steamed Bone, | C. A. Bartlett, Worcester, Mass., | Worcester. |
| 18 | Steamed Bone, | G. E. Holmes, Worcester, Mass., | Worcester. |
| 110 | S. Winter's Pure Ground Bone, | S. Winter, Brockton, Mass., | Brockton. |

## 4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen in One Hundred Pounds. Found. | Nitrogen in One Hundred Pounds. Guaranteed. | Phosphoric Acid in One Hundred Pounds. Soluble. | Reverted. | Insoluble. | Total. Found. | Total. Guaranteed. | Available. Found. | Available. Guaranteed. | Potassium Oxide in One Hundred Pounds. Found. | Potassium Oxide in One Hundred Pounds. Guaranteed. | Mechanical Analyses. Fine. | Fine Medium. | Medium. | Coarse Medium. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Compound Fertilizers.* | | | | | | | | | | | | | | | | |
| 1 | Tuttle's Fish, | 10.00 | 7.86 | 8.24—9.89 | 0.99 | 4.07 | 2.92 | 7.98 | - | 5.06 | - | - | - | | | | |
| 3 | Whittemore's Complete Manure, | 15.11 | 2.68 | 2.47—3.3 | 7.68 | 6.52 | 2.02 | 16.22 | 12—14 | 14.20 | 8—12 | 3.71 | 3—4 | | | | |
| 4 | Lowell Bone Fertilizer, | 11.46 | 2.22 | 2—2.5 | 5.19 | 8.57 | 2.23 | 15.99 | 11—16.5 | 13.76 | 9—13.5 | 2.23 | 2—3.5 | | | | |
| 8 | Potato Manure, | 10.62 | 3.91 | 3.3 | 5.36 | 1.06 | 0.91 | 7.33 | - | 6.42 | 5.75 | 9.32 | 10 | | | | |
| 14 | Hill and Drill Phosphate, | 11.15 | 2.68 | 2.5—3.25 | 6.01 | 1.84 | 6.09 | 13.94 | 12—14 | 7.85 | 8—10 | 2.15 | 2—3 | | | | |
| 19 | Fish and Potash, | 21.74 | 3.16 | 3.3—4.12 | 1.16 | 2.52 | 1.57 | 5.25 | 5—6 | 3.68 | - | 4.03 | 3—4 | | | | |
| 25 | Adams' Market Bone Fertilizer, | 12.77 | 2.52 | 2.5—3.5 | 0.32 | 3.84 | 6.42 | 10.58 | 8—10 | 4.16 | 6—8 | 5.12 | 3—5 | | | | |
| 37 | Vegetable, Vine and Tobacco Fertilizer, | 15.69 | 2.66 | 2.06—2.88 | 7.16 | 0.36 | 2.23 | 9.75 | 9—13 | 7.52 | 8—11 | 5.42 | 6—8 | | | | |
| 39 | Potato and Root Crop Manure, | 13.92 | 2.98 | 2.88—4.12 | 3.25 | 5.09 | 3.25 | 11.59 | 10—12 | 8.34 | - | 7.88 | 7—9 | | | | |
| 41 | Original Bay State Bone Superphosphate, | 20.72 | 2.70 | 2.47—2.88 | 2.64 | 4.70 | 3.15 | 10.49 | 10—12 | 7.34 | 9—9.5 | 2.95 | 2—3 | | | | |
| 44 | Ammoniated Bone Superphosphate, | 17.46 | 2.26 | 1.65—2.47 | 6.70 | 3.36 | 0.97 | 11.03 | 9—11 | 10.06 | 7—8 | 2.71 | 2—4 | | | | |
| 54 | Darling's Pure Dissolved Bone, | 11.88 | 2.10 | 2.06—2.88 | 3.61 | 12.99 | 3.51 | 20.11 | - | 16.60 | 14—16 | - | - | | | | |
| 67 | Wilcox's Dry Ground Fish Guano, | 8.22 | 7.86 | 8—11 | 0.62 | 3.91 | 3.02 | 7.55 | - | 4.53 | 4—6 | - | - | | | | |
| 7 | Quinnipiac Dry Ground Fish, | 10.00 | 7.94 | 7.5—10 | 0.64 | 3.37 | 2.85 | 6.86 | 7—10 | 4.01 | 4—6 | - | - | | | | |
| | *Bones.* | | | | | | | | | | | | | | | | |
| 2 | Steamed Bone, | 6.13 | 3.76 | 3.5—4 | 0.43 | 7.41 | 14.42 | 22.26 | 21—23 | 7.84 | - | | | 37.34 | 28.74 | 29.78 | 4.14 |
| 5 | Bone Flour, | 3.45 | 2.88 | 2.88—3.30 | 0.20 | 11.21 | 21.11 | 32.52 | 20—25 | 11.41 | - | | | 89.63 | 10.37 | - | - |
| 6 | Ground Bone, | 8.23 | 2.76 | 2.7—2.9 | 0.26 | 4.65 | 19.78 | 24.69 | 12—14 | 4.91 | - | | | 55.56 | 21.02 | 14.52 | 8.90 |
| 16 | Steamed Bone, | 5.75 | 3.42 | 3.3—4.12 | 0.54 | 11.72 | 17.42 | 29.68 | 27—30 | 12.26 | - | | | 73.05 | 19.00 | 7.95 | - |
| 17 | Steamed Bone, | 7.19 | 2.41 | 2.3—2.5 | 0.43 | 10.50 | 15.17 | 26.10 | 26—28 | 10.93 | 8—10 | | | 58.00 | 21.30 | 20.70 | - |
| 18 | Steamed Bone, | 5.77 | 2.82 | 2.5—3.5 | 1.36 | 3.09 | 16.91 | 21.36 | 22—24 | 4.45 | - | | | 48.31 | 22.70 | 18.80 | 10.19 |
| 110 | S. Winter's Pure Ground Bone, | 8.62 | 3.16 | 2.5—3.5 | 0.43 | 10.35 | 12.32 | 23.60 | 22—24 | 10.78 | - | | | 62.91 | 22.66 | 10.38 | 4.05 |

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Name of Manufacturer | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 7 | The Allen Fertilizer, | American Manufacturing Company, Boston, Mass., | Boston. |
| 24 | Mapes' Potato Manure, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Springfield. |
| 26 | Sampson Brand, or Lion Special, | Read Fertilizer Company, New York, N. Y., | Lee. |
| 27 | Farmer's Friend Special, | Read Fertilizer Company, New York, N. Y., | Lee. |
| 36 | Potato Manure, | Bradley Fertilizer Company, Boston, Mass., | North Adams. |
| 46 | Americus Ammoniated Bone Superphosphate, | Williams & Clark Co., New York, N. Y., | Northborough. |
| 93 | Brightman's Dry Ground Fish, | W. J. Brightman & Co., Tiverton, R. I., | Fall River. |
| 95 | Bay State Fertilizer, | John S. Reese & Co., Baltimore, Md., | New Bedford. |
| 96 | Reese's Concentrated Manure for Corn and Potatoes, | John S. Reese & Co., Baltimore, Md., | New Bedford. |
| 127 | Fine-ground Dry Fish, | Bowker Fertilizer Company, Boston, Mass., | Northampton. |
| | *Chemicals.* | | |
| 72 | Sulphate of Ammonia, | The Quinnipiac Company, New London, Conn., Agents, | Northampton. |
| 73 | Sulphate of Potash, | The Quinnipiac Company, New London, Conn., Agents, | Northampton. |
| 74 | Muriate of Potash, | The Quinnipiac Company, New London, Conn., Agents, | Northampton. |
| 86 | Muriate of Potash, | Bradley Fertilizer Company, Boston, Mass., Agents, | Worcester. |
| 124 | Sulphate of Potash, | Bowker Fertilizer Company, Boston, Mass., Agents, | Northampton. |
| 125 | Nitrate of Soda, | Bowker Fertilizer Company, Boston, Mass., Agents, | Northampton. |
| | *Bones.* | | |
| 31 | Pure Raw Ground Bone. | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Lee. |
| 58 | McGovern's Ground Bone, | James E. McGovern, West Andover, Mass., | West Andover. |
| 103 | Pure Fine-ground Bone, | Thos. Hersom & Co., New Bedford, Mass., | New Bedford. |
| 104 | Meat and Bone, | Thos. Hersom & Co., New Bedford, Mass., | New Bedford. |

## 4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen in One Hundred Pounds. Found. | Nitrogen in One Hundred Pounds. Guaranteed. | Phosphoric Acid in One Hundred Pounds. Soluble. | Reverted. | Insoluble. | Total. Found. | Total. Guaranteed. | Available. Found. | Available. Guaranteed. | Potassium Oxide in One Hundred Pounds. Found. | Potassium Oxide in One Hundred Pounds. Guaranteed. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 7 | The Allen Fertilizer, | 7.15 | 2.22 | 2.06—2.47 | 5.12 | 2.81 | 3.58 | 11.51 | 6—10 | 7.93 | 5—8 | 5.35 | 4—6 |
| 24 | Mapes' Potato Manure, | 9.09 | 3.76 | 3.71—4.12 | 5.85 | 3.06 | 2.53 | 11.44 | – | 8.91 | 8 | 5.68 | 6—8 |
| 26 | Sampson Brand, or Lion Special, | 10.12 | 2.80 | 2.47—3.30 | 6.06 | 2.66 | 2.60 | 11.32 | 10—12 | 8.72 | 8—10 | 4.18 | –* |
| 27 | Farmer's Friend Special, | 13.70 | 4.30 | 3.3—4.12 | 3.40 | 1.90 | 2.56 | 7.86 | 6—7 | 5.30 | 5—6 | 10.02 | 10—12 |
| 36 | Potato Manure, | 12.30 | 2.19 | 2.5—3.25 | 6.67 | 1.46 | 1.71 | 9.84 | 8—11 | 8.13 | 6—8 | 5.27 | 5—6 |
| 46 | Americus Ammoniated Bone Superphosphate, | 15.70 | 1.94 | 2—3 | 8.96 | 1.27 | 1.80 | 12.03 | 11—16 | 10.23 | 9—11 | 2.36 | 2—3 |
| 93 | Brightman's Dry Ground Fish, | 9.47 | 8.36 | 8.21—9.88 | 0.49 | 4.71 | 5.09 | 10.29 | – | 5.20 | – | – | – |
| 95 | Bay State Fertilizer, | 9.86 | 2.38 | 2.4—3.3 | 6.52 | 6.94 | 3.48 | 16.94 | – | 13.46 | 9—12 | 1.93 | 2—3 |
| 96 | Reese's Concentrated Manure for Corn and Potatoes, | 10.82 | 3.16 | 2.88—3.5 | 3.33 | 5.80 | 5.12 | 14.25 | – | 9.13 | 6—8 | 7.26 | 7.5—9.5 |
| 127 | Fine-ground Dry Fish, | 9.50 | 8.20 | 8—10 | 0.59 | 4.56 | 2.17 | 7.32 | 7—8 | 5.15 | – | – | – |
| | *Chemicals.* | | | | | | | | | | | | |
| 72 | Sulphate of Ammonia, | 2.00 | 20.40 | 19.76—21.42 | – | – | – | – | – | – | – | – | |
| 73 | Sulphate of Potash, | 5.94 | – | – | – | – | – | – | – | – | – | 24.80 | –* |
| 74 | Muriate of Potash, | 2.50 | – | – | – | – | – | – | – | – | – | 48.56 | –† |
| 86 | Muriate of Potash, | 3.50 | – | – | – | – | – | – | – | – | – | 50.12 | 48—55 |
| 124 | Sulphate of Potash, | 5.27 | – | – | – | – | – | – | – | – | – | 24.52 | 24—26* |
| 125 | Nitrate of Soda, | 1.74 | 15.10 | 14.82—15.64 | – | – | – | – | – | – | – | – | – |
| | *Bones.* | | | | | | | | | | | | |
| 31 | Pure Raw Ground Bone, | 7.69 | 3.66 | 2.88—3.3 | 0.18 | 7.40 | 16.96 | 24.54 | 25 | 7.58 | – | | |
| 58 | McGovern's Ground Bone, | 12.89 | 1.66 | 1.5—2.25 | 0.20 | 6.84 | 12.87 | 19.91 | 18—20 | 7.04 | – | | |
| 103 | Pure Fine-ground Bone, | 3.32 | 1.80 | 1.75—2.25 | 0.24 | 8.02 | 22.03 | 30.29 | 27—30 | 8.26 | – | | |
| 104 | Meat and Bone, | 4.45 | 4.76 | 4—5 | 0.28 | 6.76 | 11.37 | 18.41 | 18—20 | 7.04 | – | | |

| Laboratory Number. | Name of Brand. | Mechanical Analyses. Fine. | Fine Medium. | Medium. | Coarse Medium. |
|---|---|---|---|---|---|
| 31 | Pure Raw Ground Bone, | 34.05 | 27.55 | 22.00 | 16.40 |
| 58 | McGovern's Ground Bone, | 39.85 | 32.30 | 18.35 | 9.50 |
| 103 | Pure Fine-ground Bone, | 51.32 | 33.83 | 13.04 | 1.81 |
| 104 | Meat and Bone, | – | – | – | – |

* Sulphate of potash, the source of potash.

† Guaranteed 80—85 per cent. muriate of potash.

*4. Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Name of Manufacturer. | Sampled at — |
|---|---|---|---|
| 21 | Tobacco and Sulphur Lawn Fertilizer, | F. C. Sturtevant, Hartford, Conn., | Springfield. |
| 32 | Potato, Hop and Tobacco Phosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Lee. |
| 35 | XL Superphosphate of Lime, | Bradley Fertilizer Company, Boston, Mass., | North Adams. |
| 40 | Darling's Animal Fertilizer, | L. B. Darling Fertilizer Company, Pawtucket, R. I., | North Framingham. |
| 42 | Ammoniated Wheat and Corn Manure, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Framingham. |
| 47 | The Ames Fertilizer, | Ames Fertilizer Company, Peabody, Mass., | North Sudbury. |
| 48 | The N. Ward Company's High-grade Animal Fertilizer, | The N. Ward Company, Boston, Mass., | Boston. |
| 49 | Red Star Brand 203 Fertilizer for General Crops, | Le Page Company, Boston, Mass., | Woburn. |
| 56 | The Lawrence Fertilizer, | A. Lee & Co., Lawrence, Mass., | Lawrence. |
| 60 | Lister's Success Fertilizer, | Lister Agricultural and Chemical Works, Newark, N. J., | Lowell. |
| 83 | Cumberland Seeding-down Fertilizer, | Cumberland Bone Company, Portland, Me., | Jefferson's. |
| 97 | Clark's Cove King Philip Alkaline Guano, | John S. Reese & Co., Baltimore, Md., Licensees, | New Bedford. |
| 98 | Clark's Cove Great Planet A. A. Manure, | John S. Reese & Co., Baltimore, Md., Licensees, | New Bedford. |
| 105 | Standard Fertilizer, | Standard Fertilizer Company, Boston, Mass., | Taunton. |
| 106 | Potato Fertilizer, | E. Frank Coe, New York City, N. Y., | Taunton. |
| 115 | Cumberland Superphosphate, | Cumberland Bone Company, Portland, Me., | Sunderland. |
| 128 | Fish and Potash, Anchor Brand, | Bradley Fertilizer Company, Boston, Mass., | Northampton. |
| 130 | Dry Fish Guano, | Bradley Fertilizer Company, Boston, Mass., | Northampton. |
| 137 | Nitrogenous Superphosphate, | J. C. Dow & Co., Boston, Mass., | Cambridgeport. |
| 146 | Soluble Pacific Guano, | W. D. Stewart & Co., Boston, Mass., | Berlin. |
| 147 | Special Favorite, | Davidge Fertilizer Company, New York City, N. Y., | Barre Plains. |

*4. Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen in One Hundred Pounds. | | Phosphoric Acid in One Hundred Pounds. | | | | | | | Potassium Oxide in One Hundred Pounds. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Total. | | Available. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| 21 | Tobacco and Sulphur Lawn Fertilizer, | 22.06 | 1.96 | 2.38 | - | - | - | 0.71 | 0.75 | - | - | 7.80 | 7.66 |
| 32 | Potato, Hop and Tobacco Phosphate, | 14.23 | 2.08 | 2—3 | 7.65 | 1.74 | 1.78 | 11.17 | 11—15 | 9.39 | 10—13 | 4.24 | 3.5—4.5 |
| 35 | XL Superphosphate of Lime, | 13.87 | 2.66 | 2.5—3 | 7.14 | 2.46 | 1.79 | 11.39 | 11—14 | 9.60 | 9—11 | 1.91 | 2—3 |
| 40 | Darling's Animal Fertilizer, | 12.33 | 2.83 | 3.3—4.94 | 4.03 | 3.69 | 4.66 | 12.38 | - | 7.72 | 10—12 | 5.87 | 4—6 |
| 42 | Ammoniated Wheat and Corn Manure, | 15.61 | 2.02 | 2—3 | 8.47 | 2.23 | 0.61 | 11.31 | 11—15 | 10.70 | 10—13 | 1.80 | 1.75—2.93 |
| 47 | The Ames Fertilizer, | 21.22 | 3.12 | 2.47—3.3 | 5.05 | 4.53 | 0.42 | 10.00 | 8—12 | 9.58 | 7—10 | 1.04 | 0.75—2 |
| 48 | N. Ward & Co.'s High-grade Animal Fertilizer, | 18.25 | 3.29 | 2.88—3.7 | 5.40 | 5.64 | 1.11 | 12.18 | - | 11.04 | 12—14 | 4.76 | 4—5 |
| 49 | Red Star Brand 203 Fertilizer for General Crops, | 13.65 | 3.30 | 3—4 | 4.44 | 2.61 | 2.14 | 9.19 | 10—12 | 7.05 | 8—10 | 4.20 | 3—4 |
| 56 | The Lawrence Fertilizer, | 14.06 | 2.32 | 2.06—2.88 | 6.45 | 6.12 | 2.56 | 15.43 | - | 12.87 | 10—12 | 1.94 | 2—3 |
| 60 | Lister's Success Fertilizer, | 11.99 | 1.52 | 1.03—1.65 | 8.11 | 1.54 | 2.25 | 11.90 | - | 9.65 | 10.5—12 | 1.69 | 1.5—2 |
| 83 | Cumberland Seeding-down Fertilizer, | 13.89 | 1.62 | 1.65 | 2.35 | 6.20 | 6.59 | 18.14 | 18—20 | 8.55 | 5—9 | 1.05 | 1 |
| 97 | Clark's Cove King Philip Alkaline Guano, | 12.30 | 1.70 | 1.24—1.65 | 5.20 | 3.04 | 2.20 | 10.44 | - | 8.24 | 6.5—8 | 3.42 | 3—4 |
| 98 | Clark's Cove Great Planet A. A. Manure, | 10 21 | 3.22 | 2.88—3.71 | 4.89 | 2.24 | 2.67 | 9.80 | - | 7.13 | 6—8 | 7.85 | 7.5—9.5 |
| 105 | Standard Fertilizer, | 13.85 | 2.66 | 2—3 | 7.79 | 1.63 | 1.54 | 10.96 | 10—15 | 9.42 | 8—12 | 2.09 | 2—3 |
| 106 | Potato Fertilizer, | 12.35 | 2.16 | 2—2.5 | 6.75 | 2.89 | 1.46 | 11.10 | - | 9.64 | 8—11 | 6.89 | 6 |
| 115 | Cumberland Superphosphate, | 14.28 | 2.20 | 2—3 | 5.01 | 2.28 | 8.09 | 15 38 | 12—14 | 7.29 | 9—13 | 2.24 | 2—3 |
| 128 | Fish and Potash, Anchor Brand, | 18.71 | 3.72 | 3.25—4.25 | 4.22 | 1.44 | 1.13 | 7.09 | - | 5.66 | 3—5 | 4.30 | 3—5 |
| 130 | Dry Fish Guano, | 12.38 | 8.48 | 8.24—9.88 | 0.08 | 3.55 | 4.07 | 7.70 | 6—8 | 3.63 | - | - | - |
| 137 | Nitrogenous Superphosphate, | 15.84 | 2.48 | 2.06—2.88 | 5 32 | 4.41 | 2.17 | 11.90 | - | 9.73 | 8—10 | 3.17 | 3—4 |
| 146 | Soluble Pacific Guano, | 17.28 | 2.60 | 2.25—3 | 7.93 | 1.89 | 2.56 | 12.38 | 10.5—16 | 9.82 | 8.5—11 | 2.42 | 2—3 |
| 147 | Special Favorite, | 18.38 | 1.64 | 1.24—2.06 | 9.98 | 1.49 | 0.03 | 11.41 | 11—14 | 11.38 | 10—12 | 1.82 | 1.5—2.5 |

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number | Name of Brand. | Name of Manufacturer. | Sampled at — |
|---|---|---|---|
| 29 | Farmer's Friend Superphosphate. | Read Fertilizer Company, New York, N. Y., | Lee. |
| 30 | Ammoniated Bone Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Lee. |
| 45 | Chittenden's Potato Manure, | National Fertilizer Company, Bridgeport, Conn., | Northborough. |
| 49 | Red Star Brand 203 Fertilizer for General Crops, | Le Page Company, Boston, Mass., | Woburn. |
| 52 | Cleveland Potato Phosphate, | Cleveland Dryer Company, Cleveland, Ohio, | South Framingham. |
| 64 | Mapes' Complete Manure for General Use, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Lowell. |
| 90 | Quinnipiac Phosphate, | The Quinnipiac Company, New London, Conn., | Fall River. |
| 119 | Fish and Potash, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 132 | Tobacco Manure, Wrapper Brand, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Northampton. |
| 148 | IXL Ammoniated Bone Superphosphate, | The Miles Fertilizer and Oil Company, Milford, Conn., | Northampton. |
| 151 | Soluble Bone Phosphate, | Davidge Fertilizer Company, New York, N. Y., | Williamsburg. |
| | *Bones.* | | |
| 20 | Ground Bone, | H. J. Baker & Bro., New York, N. Y., | Springfield. |
| 55 | Royal Pure Ground Bone, | A. Lee & Co., Lawrence, Mass., | Lawrence. |
| 59 | Chittenden's Ground Bone, | National Fertilizer Company, Bridgeport, Conn., | Lawrence. |
| 61 | Lister's Celebrated Bone, | Lister Agricultural and Chemical Works, Newark, N. J., | Lowell. |
| 71 | Quinnipiac Pure Bone Meal, | The Quinnipiac Company, New London, Conn., | Northampton. |
| 78 | Bowker's Fine-ground Bone, | Bowker Fertilizer Company, Boston, Mass., | Northampton |
| 89 | Hargrave's Bone, | Hargrave Manufacturing Company, Fall River, Mass., | Fall River. |
| 111 | Ground Bone, | Edmund Hersey, Hingham, Mass., | Hingham. |
| 138 | Fine-ground Bone, | J. C. Dow & Co., Boston, Mass., | Cambridgeport. |
| 141 | Pure Ground Bone, | Wm. Lavery, Amesbury, Mass., | Amesbury. |

## 4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen in One Hundred Pounds. Found. | Nitrogen in One Hundred Pounds. Guaranteed. | Phosphoric Acid in One Hundred Pounds. Soluble. | Reverted. | Insoluble. | Total. Found. | Total. Guaranteed. | Available. Found. | Available. Guaranteed. | Potassium Oxide in One Hundred Pounds. Found. | Potassium Oxide in One Hundred Pounds. Guaranteed. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 29 | Farmer's Friend Superphosphate, | 14.80 | 2.60 | 2.06—2.47 | 6.98 | 3.00 | 2.70 | 12.68 | 11—13 | 9.98 | 9—11 | 2.40 | —* |
| 30 | Ammoniated Bone Superphosphate, | 11.77 | 3.25 | 2.88—3.71 | 6.54 | 0.49 | 3.42 | 10.45 | 11—15 | 7.03 | 10—13 | 1.41 | 1—2 |
| 45 | Chittenden's Potato Manure, | 10.10 | 3.30 | 3.29—4.12 | 3.68 | 4.08 | 4.64 | 12.40 | - | 7.76 | 6—8 | 6.28 | 6—8 |
| 49 | Red Star Brand 203 Fertilizer for General Crops, | 13.65 | 3.30 | 3—4 | 4.44 | 2.61 | 2.14 | 9.19 | 10—12 | 7.05 | 8—10 | 4.20 | 3—4 |
| 52 | Cleveland Potato Phosphate, | 16.97 | 2.18 | 2.05—2.85 | 7.89 | 1.28 | 0.55 | 9.72 | - | 9.17 | 8—10 | 3.76 | 3.25—4.25 |
| 64 | Mapes' Complete Manure for General Use, | 15.47 | 3.44 | 3.29—4.12 | 3.79 | 4.85 | 3.33 | 11.97 | 10—12 | 8.64 | 8—10 | 3.96 | 4—5 |
| 90 | Quinnipiac Phosphate, | 21.76 | 2.80 | 2.5—3.5 | 2.71 | 7.14 | 0.77 | 10.62 | 10—16 | 9.85 | 9—13 | 2.42 | 2—3 |
| 119 | Fish and Potash, | 6.02 | 3.70 | 3.29—4.12 | 2.62 | 2.78 | 1.09 | 6.49 | 5—6 | 5.40 | - | 5.03 | 4—6 |
| 132 | Tobacco Manure, Wrapper Brand, | 1.49 | 5.98 | 6.18 | 0.92 | 3.50 | 2.56 | 6.98 | 4.5 | 4.42 | - | 11.05 | 10.50 |
| 148 | IXL Ammoniated Bone Superphosphate, | 15.14 | 2.96 | 2.06—3.30 | 8.64 | 0.81 | 0.19 | 9.64 | 9—14 | 9.45 | 8—12 | 2.27 | 1.5—3 |
| 151 | Soluble Bone Phosphate, | 11.60 | - | - | 8.30 | 2.48 | 0.22 | 11.00 | 11—14 | 10.78 | 10—12 | 1.90 | 1.5—2.5 |

*Bones.*

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen Found. | Nitrogen Guaranteed. | Soluble. | Reverted. | Insoluble. | Total. Found. | Total. Guaranteed. | Available. Found. | Available. Guaranteed. | Mechanical Analyses. Fine. | Fine Medium. | Medium. | Coarse Medium. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | Ground Bone, | 11.07 | 4.22 | 3.85 | 0.08 | 6.14 | 14.43 | 20.65 | 23.75 | 6.22 | - | 52.65 | 41.90 | 5.45 | - |
| 55 | Royal Pure Ground Bone, | 9.76 | 3.80 | 4—5 | 0.16 | 11.14 | 13.50 | 24.80 | 25—27 | 11.30 | - | 39.10 | 25.50 | 18.30 | 17.10 |
| 59 | Chittenden's Ground Bone, | 6.00 | 3.04 | 2.88—3.71 | 0.15 | 5.10 | 19.34 | 24.59 | 20—24 | 5.25 | - | 18.64 | 31.78 | 38.09 | 11.49 |
| 61 | Lister's Celebrated Bone, | 6.16 | 2.50 | 2.47—2.88 | 0.43 | 7.63 | 6.73 | 14.79 | 12—18 | 8.06 | - | 31.96 | 28.82 | 19.01 | 20.21 |
| 71 | Quinnipiac Pure Bone Meal, | 19.23 | 2.76 | 2.47—4.12 | 0.20 | 11.43 | 12.22 | 23.85 | 22—25 | 11.63 | - | 32.74 | 33.18 | 18.69 | 15.39 |
| 78 | Bowker's Fine-ground Bone, | 5.81 | 3.20 | 2.47—3.30 | 0.33 | 8.23 | 13.19 | 21.75 | 18—22 | 8.56 | - | 57.32 | 23.19 | 13.89 | 5.60 |
| 89 | Hargrave's Bone, | 11.48 | 3.10 | 2.5—3.5 | - | 7.58 | 17.78 | 25.36 | 23—25 | 7.58 | - | 31.12 | 24.78 | 18.22 | 25.88 |
| 111 | Ground Bone, | 2.99 | 2.90 | 3—4 | 0.38 | 9.06 | 18.64 | 28.08 | 19—25 | 9.44 | - | 46.37 | 30.08 | 19.64 | 3.91 |
| 138 | Fine-ground Bone, | 2.67 | 2.08 | 1.65—2.47 | 0.61 | 6.74 | 19.52 | 26.87 | 24—26 | 7.35 | - | 70.13 | 28.70 | 1.17 | - |
| 114 | Pure Ground Bone, | 14.68 | 2.52 | 2—3 | - | 4.94 | 9.34 | 14.28 | 12—18 | 4.94 | - | 47.10 | 44.19 | 8.71 | - |

* Sulphate of potash, the source of potash.

## 4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Name of Manufacturer. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 9 | Lawn Dressing, | H. J. Baker & Bro., New York, N. Y., | Boston. |
| 10 | A. A. Ammoniated Superphosphate, | H. J. Baker & Bro., New York, N. Y., | Boston. |
| 11 | Square Brand Bone and Potash, | Bowker Fertilizer Company, Boston, Mass., | North Sudbury. |
| 12 | Ammoniated Bone Fertilizer, | Bowker Fertilizer Company, Boston, Mass., | North Sudbury. |
| 13 | Stockbridge's Manure for Asparagus, | Bowker Fertilizer Company, Boston, Mass., | North Sudbury. |
| 15 | Stockbridge's Manure for Vegetables and Potatoes, | Bowker Fertilizer Company, Boston, Mass., | North Sudbury. |
| 28 | Lion Brand, | Read Fertilizer Company, New York, N. Y., | Lee. |
| 38 | Grass and Grain Fertilizer, | Great Eastern Fertilizer Company, Rutland, Vt., | Framingham. |
| 50 | Mayo's Superphosphate, | C. E. Mayo & Co., Boston, Mass., | Woburn. |
| 53 | Breck's Lawn Dressing, | Bowker Fertilizer Company, Boston, Mass., | Boston. |
| 63 | Chittenden's Universal Phosphate, | National Fertilizer Company, Bridgeport, Conn., | Lawrence. |
| 66 | Mapes' Grass and Grain Spring Top-dressing. | Mapes' Formula and Peruvian Guano Company, New York, N. Y., | Lowell. |
| 68 | Wilcox Prepared Fertilizer, | Leander Wilcox, Mystic Bridge, Conn., | Amherst. |
| 69 | Wilcox Fish and Potash, | Leander Wilcox, Mystic Bridge, Conn., | Amherst. |
| 75 | Quinnipiac Fish and Potash, Cross Brand, | The Quinnipiac Company, New London, Conn., | Northampton. |
| 79 | Bowker's Square Brand Fish and Potash, | Bowker Fertilizer Company, Boston, Mass., | Northampton. |
| 84 | Jefferd's Animal Fertilizer with Potash, | J. G. Jefferds, Worcester, Mass., | Worcester. |
| 85 | Bartlett's Animal Fertilizer with Potash, | C. A. Bartlett, Worcester, Mass., | Worcester. |
| 99 | Clark's Cove Fish and Potash, | John S. Reese & Co., Baltimore, Md., | New Bedford. |
| 100 | Clark's Cove New England Favorite, | John S. Reese & Co., Baltimore, Md., | New Bedford. |
| 102 | Red Star Brand Special for Potatoes, | Le Page Company, Boston, Mass., | New Bedford. |

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen in One Hundred Pounds. | | Phosphoric Acid in One Hundred Pounds. | | | | | | | Potassium Oxide in One Hundred Pounds. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Total. | | Available. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| 9 | Lawn Dressing, | 18.87 | 4.16 | 3.50 | 4.66 | 1.75 | 0.38 | 6.79 | - | 6.41 | 4.75 | 6.81 | 7.00 |
| 10 | A. A. Ammoniated Superphosphate, | 14.55 | 2.63 | 2.47—3.30 | 10.08 | 0.82 | 0.14 | 11.04 | - | 10 90 | 10—12 | 2.38 | 2—3 |
| 11 | Square Brand Bone and Potash, | 6 00 | 1.56 | 1.65—2.47 | 0.92 | 5.78 | 7.19 | 13.89 | - | 6.70 | 12—15 | 1.96 | 2—3 |
| 12 | Ammoniated Bone Fertilizer, | 12.85 | 2.21 | 2—3 | 2.72 | 3.95 | 5.73 | 12.40 | 10—12 | 6.67 | 8—10 | 2.43 | 2—3 |
| 13 | Stockbridge's Manure for Asparagus, | 11.94 | 3.54 | 3.25—4.25 | 2.93 | 2.48 | 4.73 | 10.14 | 8—10 | 5.41 | 7—8 | 5.06 | 5—6 |
| 15 | Stockbridge's Manure for Vegetables and Potatoes, | 10.97 | 4.12 | 3.25—4.25 | 2.87 | 4.72 | 4.58 | 12.17 | 8—10 | 7.59 | 7—8 | 5.23 | 5—6 |
| 28 | Lion Brand, | 14.16 | 1.12 | 0.82—1.65 | 5.86 | 3.33 | 1.91 | 11.10 | 10—12 | 9.19 | 8—10 | 4 22 | -* |
| 38 | Grass and Grain Fertilizer, | 13.61 | 3.19 | 2.88—3.71 | 6.42 | 1.67 | 2.12 | 10.21 | 9—15 | 8.09 | 8—12 | 1.73 | 2—4 |
| 50 | Mayo's Superphosphate, | 17.11 | 2.50 | 2.05—2.85 | 8.15 | 0.85 | 1.23 | 10.23 | 10—14 | 9.00 | 9—12 | 2.46 | 2.5—3.5 |
| 53 | Breck's Lawn Dressing, | 9.41 | 3.84 | 4.12—4.94 | 2.20 | 3.09 | 6.97 | 12.26 | - | 5.29 | 5—6 | 5.03 | 5—6 |
| 63 | Chittenden's Universal Phosphate, | 15.15 | 2.65 | 2.06—2.88 | 4.95 | 3.62 | 2.57 | 11.14 | 11—12 | 8.57 | 9—11 | 3.19 | 2—3 |
| 66 | Mapes Grass and Grain Spring Top-dressing, | 12.00 | 4.16 | 4.12—5.77 | 3.35 | 3.80 | 2.60 | 9.75 | 7—9 | 7.15 | 7 | 5.44 | 5—7 |
| 68 | Wilcox Prepared Fertilizer, | 24.76 | 3.51 | 3.30—4.12 | 3.38 | 2.07 | 1.51 | 6.96 | - | 5.45 | 5.5—7.5 | 3 65 | - |
| 69 | Wilcox Fish and Potash, | 21.40 | 3.86 | 3.5—4.5 | 2.82 | 2.46 | 1.25 | 6.53 | 5—7 | 5.28 | - | 4.02 | 4—6 |
| 75 | Quinnipiac Fish and Potash, Cross Brand, | 21.24 | 3.37 | 3.25—4.25 | 2.17 | 2.82 | 1.71 | 6.70 | - | 4.99 | 2—5 | 4.16 | 3—5 |
| 79 | Bowker's Square Brand Fish and Potash, | 14.50 | 2 64 | 2.25—3.25 | 3.74 | 2.75 | 2 87 | 9.36 | 8—10 | 6.49 | - | 4.01 | 4—6 |
| 84 | Jefferd's Animal Fertilizer with Potash, | 4.93 | 3 60 | 4.12—5.77 | 0.13 | 12.05 | 5.78 | 17.96 | 14—16 | 12.18 | - | 5.28 | 5—7 |
| 85 | Bartlett's Animal Fertilizer with Potash, | 4.34 | 4.46 | 3.30—4.12 | 0.15 | 5.83 | 7.00 | 12.98 | 16—18 | 5.98 | - | 5.84 | 7—8 |
| 99 | Clark's Cove Fish and Potash, | 13.26 | 3.28 | 2.47—4.12 | 2.57 | 3.85 | 2.71 | 9.13 | - | 6.42 | 6—8 | 4.90 | 3—5 |
| 100 | Clark's Cove New England Favorite, | 13.19 | 2.54 | 2.27—2.68 | 5.86 | 3.42 | 3.67 | 12.95 | - | 9.28 | 9—11 | 2.03 | 2—2.5 |
| 102 | Red Star Brand Special for Potatoes, | 15.87 | 2.69 | 3—4 | 2.33 | 3.56 | 3 15 | 9.04 | 8—10 | 5.89 | 6—8 | 4.70 | 5—6 |

* Sulphate of potash, the source of potash

## 4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Name of Manufacturer. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 107 | High-grade Ammoniated Bone Superphosphate, | E. Frank Coe, New York, N. Y., | Taunton. |
| 108 | Standard Ground Bone and Potash, | B. Randall, 113 Central St., Boston, Mass., | Boston. |
| 112 | Potato Fertilizer, | H. S. Miller & Co., Newark, N. J., | Sunderland. |
| 113 | Standard Superphosphate, | H. S. Miller & Co., Newark, N. J., | Sunderland. |
| 116 | Onion, Potato and Tobacco Manure, | The Quinnipiac Company, New London, Conn., | South Deerfield. |
| 117 | Pequot Fish and Potash, | The Quinnipiac Company, New London, Conn., | South Deerfield. |
| 118 | Potato Manure, | The Quinnipiac Company, New London, Conn., | South Deerfield. |
| 120 | Phelps' Phosphate, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 121 | Phelps' Complete Manure for Top-dressing, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 129 | Complete Manure for Top-dressing Grass and Grain, | Bradley Fertilizer Company, Boston, Mass., | Northampton. |
| 131 | Fish and Potash, "A" Brand, | Bradley Fertilizer Company, Boston, Mass., | Northampton. |
| 133 | Grass and Grain Spring Top-dressing, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Northampton. |
| 135 | Fish and Potash, "D" Brand, | Joseph Church & Co., Tiverton, R. I., | Stoughton. |
| 136 | Imperial Bone Superphosphate, | J. A. Tucker & Co., Boston, Mass., | Boston. |
| 139 | Ground Bone Fertilizer, | J. C. Dow & Co., Boston, Mass., | Cambridgeport. |
| 140 | Standard Superphosphate, | Standard Fertilizer Company, Boston, Mass., | Ipswich. |
| 142 | Lavery's Superphosphate, | Wm. Lavery, Amesbury, Mass., | Amesbury. |
| 143 | Ammoniated Dissolved Bone Phosphate, | H. S. Miller & Co., Newark, N. J., | Clinton. |
| 144 | Harvest Queen Phosphate, | H. S. Miller & Co., Newark, N. J., | Clinton. |
| 145 | Vegetable Bone Superphosphate, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Clinton. |
| 149 | Fish and Potash, | The Miles Fertilizer and Oil Company, Milford, Conn., | Northampton. |

## 4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen in One Hundred Pounds. | | Phosphoric Acid in One Hundred Pounds. | | | | | | | Potassium Oxide in One Hundred Pounds. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Total. | | Available. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 107 | High-grade Ammoniated Bone Superphosphate, | 13.46 | 2.24 | 2—2.5 | 7.92 | 2.29 | 2.11 | 12.32 | 11—15 | 10.21 | 9—12 | 1.78 | 2 |
| 108 | Standard Ground Bone and Potash, | 10.18 | 2.64 | 1.6—2.5 | 0.95 | 7.89 | 7.79 | 16.63 | 13—16 | 8.84 | 5—7 | 1.88 | 2 |
| 112 | Potato Fertilizer, | 9.77 | 4.86 | 3.71—4.12 | 3.66 | 2.89 | 0.91 | 7.45 | - | 6.55 | 8.5—10 | 7.66 | 7—8 |
| 113 | Standard Superphosphate, | 16.74 | 2.80 | 2.35—2.68 | 9.30 | 1.06 | 0.40 | 10.76 | 11.5—14.5 | 10.36 | 10—12 | 2.20 | 1.5—2 |
| 116 | Onion, Potato and Tobacco Manure, | 16.05 | 3.26 | 3.25—4.25 | 2.39 | 7.04 | 1.62 | 11.05 | 9—14 | 9.43 | 8—11 | 6.52 | 7—8 |
| 117 | Pequot Fish and Potash, | 9.50 | 2.86 | 2.5—3.25 | 0.20 | 4.28 | 3.67 | 8.15 | - | 4.48 | 3—5 | 5.15 | 4—6 |
| 118 | Potato Manure, | 14.04 | 3.57 | 2.5—3.25 | 1.71 | 4.97 | 3.11 | 9.79 | 6—11 | 6.68 | 5—9 | 5.81 | 5—6 |
| 120 | Phelps' Phosphate, | 15.51 | 2.78 | 2.47—3.30 | 10.26 | 0.69 | 0.33 | 11.28 | 10—12 | 10.95 | - | 3.02 | 3—4 |
| 121 | Phelps' Complete Manure for Top-dressing, | 9.83 | 5.63 | 4.12—4.94 | 5.23 | 2.46 | 0.32 | 8.01 | 7—8 | 7.69 | 4—5 | 8.27 | 8—10 |
| 129 | Complete Manure for Top-dressing Grass and Grain, | 10.29 | 4.94 | 4.94—5.77 | 3.53 | 3.02 | 0.26 | 6.81 | - | 6.55 | 5—7 | 3.13 | 2.5—3.5 |
| 131 | Fish and Potash, "A" Brand, | 23.34 | 2.86 | 2—3 | 3.94 | 2.60 | 0.96 | 7.50 | - | 6.54 | 4—6 | 3.94 | 4—6 |
| 133 | Grass and Grain Spring Top dressing, | 10.93 | 5.02 | 4.12—5.77 | 3.93 | 2.66 | 2.56 | 9.15 | 7—9 | 6.59 | 7 | 6.26 | 5—7 |
| 135 | Fish and Potash, "D" Brand, | 18.59 | 3.36 | 3.30—4.12 | 1.05 | 2.92 | 1.66 | 5.63 | 5—6 | 3.97 | - | 4.62 | 3—4 |
| 136 | Imperial Bone Superphosphate, | 18.48 | 2.50 | 2.06—2.47 | 0.86 | 5.60 | 3.89 | 10.35 | 9—10 | 6.46 | 8—9 | 2.45 | 2.5—3 |
| 139 | Ground Bone Fertilizer, | 5.65 | 1.73 | 1.65—2.47 | 0.43 | 5.62 | 16.11 | 22.16 | 18—22 | 6.05 | - | 2.86 | 3—4 |
| 140 | Standard Superphosphate, | 12.98 | 2.32 | 2.5—3.5 | 8.80 | 2.02 | 1.19 | 12.01 | 11—16 | 10.82 | 9—13 | 1.83 | 2—3 |
| 142 | Lavery's Superphosphate, | 11.86 | 2.04 | 1.97 | 2.28 | 4.39 | 5.71 | 12.38 | 10.17 | 6.67 | 7.08 | 2.60 | 2.36 |
| 143 | Ammoniated Dissolved Bone Phosphate, | 11.50 | 1.82 | 1.65—2.06 | 7.57 | 2.18 | 0.46 | 10.21 | 9.5—12.5 | 9.75 | 8—10 | 1.90 | 1.5—2 |
| 144 | Harvest Queen Phosphate, | 6.22 | 1.04 | 0.82—1.65 | 3.10 | 8.11 | 1.25 | 12.46 | 10—12 | 11.21 | 10—12 | 1.83 | 1.5—2 |
| 145 | Vegetable Bone Superphosphate, | 13.24 | 5.80 | 4.94—5.77 | 4.20 | 3.82 | 0.42 | 8.44 | 9—7 | 8.02 | 6—7 | 6.10 | -* |
| 149 | Fish and Potash, | 21.50 | 3.06 | 3.30—4.94 | 5.91 | 0.12 | 1.13 | 7.16 | - | 6.03 | 5—8 | 4.10 | 4—6 |

* Sulphate of potash, the source of potash.

4. *Analyses of Commercial Fertilizers, etc.* — Continued.

| Laboratory Number. | Name of Brand. | Name of Manufacturer. | Sampled at — |
|---|---|---|---|
| | *Compound Fertilizers.* | | |
| 22 | Lawn and Garden Dressing, | Bowker Fertilizer Company, Boston, Mass., | Springfield. |
| 23 | Stockbridge's Manure for Top-dressing, | Bowker Fertilizer Company, Boston, Mass., | Springfield. |
| 34 | Original Coe's Superphosphate of Lime, | Bradley Fertilizer Company, Boston, Mass., | Lee. |
| 43 | Special Potato Manure, | Crocker Fertilizer and Chemical Company, Buffalo, N. Y., | Framingham |
| 62 | Darling's Fertilizer for Lawn and Gardens, | L. B. Darling Fertilizer Company, Pawtucket, R. I., | Lowell. |
| 65 | Mapes' Fruit and Vine Manure, | Mapes Formula and Peruvian Guano Company, New York, N. Y., | Lowell. |
| 70 | Ammoniated Dissolved Bone, | Quinnipiac Company, New London, Conn., | Northampton. |
| 80 | Stockbridge's Manure for Onions, | Bowker Fertilizer Company, Boston, Mass., | Northampton. |
| 88 | Potato Phosphate, | Williams & Clark Co., New York, N. Y., | Worcester. |
| 91 | Quinnipiac Market Garden Manure, | The Quinnipiac Company, New London, Conn., | Fall River. |
| 92 | Brightman's Fish and Potash, | W. J. Brightman & Co., Tiverton, R. I., | Fall River. |
| 94 | Complete Grass Manure, | H. J. Baker & Bro., New York, N. Y., | Fall River. |
| 101 | Clark's Cove Pilgrim Fertilizer, | John S. Reese & Co., Baltimore, Md., Licensees, | New Bedford. |
| 109 | Market Garden Fertilizer, | B. Randall, Boston, Mass., | Boston. |
| 114 | Tobacco Fertilizer, | H. S. Miller & Co., Newark, N. J., | South Deerfield. |
| 122 | Phelps' Complete Manure for Corn, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 123 | Phelps' Complete Manure for Potatoes, | Prentiss, Brooks & Co., Holyoke, Mass., | Holyoke. |
| 150 | Special Favorite, | Davidge Fertilizer Company, New York, N. Y., | Williamsburg. |

## 4. *Analyses of Commercial Fertilizers, etc.* — Concluded.

| Laboratory Number. | Name of Brand. | Moisture. | Nitrogen in One Hundred Pounds. | | Phosphoric Acid in One Hundred Pounds. | | | | | | | Potassium Oxide in One Hundred Pounds. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Total. | | Available. | | | |
| | | | Found. | Guaranteed. | Soluble. | Reverted. | Insoluble. | Found. | Guaranteed. | Found. | Guaranteed. | Found. | Guaranteed. |
| | *Compound Fertilizers.* | | | | | | | | | | | | |
| 22 | Lawn and Garden Dressing, | 10.35 | 4.29 | 4—5 | 3.44 | 2.70 | 3.98 | 10.12 | - | 6.14 | 5—6 | 4.46 | 5—6 |
| 23 | Stockbridge's Manure for Top-dressing, | 6.20 | 4.56 | 5—6 | 3.25 | 3.68 | 5.40 | 12.33 | - | 6.93 | 6—7 | 4.76 | 5—6 |
| 34 | Original Coe's Superphosphate of Lime, | 14.89 | 2.34 | 2.05—2.85 | 8.84 | 1.36 | 1.66 | 11.86 | 10—14 | 10.20 | 8—11 | 1.87 | 1—2 |
| 43 | Special Potato Manure, | 21.07 | 3.18 | 3.7—4.5 | 5.48 | 1.97 | 2.09 | 9.54 | 7—10 | 7.45 | 6—8 | 4.86 | -* |
| 62 | Darling's Fertilizer for Lawn and Gardens, | 16.40 | 4.22 | 4—6 | 3.24 | 6.82 | 1.94 | 12.00 | 10—12 | 10.06 | - | 5.99 | 5—6 |
| 65 | Mapes' Fruit and Vine Manure, | 14.10 | 2.30 | 1.65—2.47 | 7.11 | 0.36 | 0.51 | 7.98 | 7—9 | 7.47 | - | 12.22 | 11—12 |
| 70 | Ammoniated Dissolved Bone, | 14.69 | 1.94 | 1.65—2.47 | 3.52 | 6.24 | 1.70 | 11.46 | 11—14 | 9.76 | 9—12 | 2.54 | 4—6 |
| 80 | Stockbridge's Manure for Onions, | 18.87 | 3.05 | 3.25—4.25 | 5.83 | 3.05 | 1.15 | 10.03 | 8—10 | 8.88 | 7—8 | 4.58 | 5—6 |
| 88 | Potato Phosphate, | 11.28 | 2.52 | 2—3 | 5.89 | 2.64 | 1.88 | 10.41 | - | 8.53 | 6—8 | 6.12 | 6—8 |
| 91 | Quinnipiac Market Garden Manure, | 16.07 | 3.68 | 3.25—4.25 | 3.09 | 6.30 | 1.19 | 10.58 | - | 9.39 | 8—11 | 6.34 | 7—8 |
| 92 | Brightman's Fish and Potash, | 20.91 | 3.80 | 2.47—4.12 | 1.79 | 2.54 | 1.30 | 5.63 | 6—7 | 4.33 | 2—3 | 3.67 | 2—3 |
| 94 | Complete Grass Manure, | 18.70 | 3.20 | 3.71 | 4.82 | 1.60 | 0.28 | 6.70 | - | 6.42 | 5 | 8.35 | 7 |
| 101 | Clark's Cove Pilgrim Fertilizer, | 17.56 | 1.36 | 1.03—2.68 | 5.53 | 1.95 | 1.97 | 9.45 | - | 7.48 | 6.5—7.5 | 3.11 | 2.5—3.5 |
| 109 | Market Garden Fertilizer, | 17.89 | 3.76 | 1.65—2.47 | 4.41 | 5.52 | 0.29 | 10.22 | 10—16 | 9.93 | 8—10 | 2.97 | 2—4 |
| 114 | Tobacco Fertilizer, | 19.24 | 5.30 | 5.35 | 0.36 | 0.75 | 1.13 | 2.24 | - | 1.11 | 3—4 | 7.89 | 5.5 |
| 122 | Phelps' Complete Manure for Corn, | 13.59 | 4.36 | 4.12—4.94 | 7.41 | 3.90 | 0.56 | 11.87 | 8—10 | 11.31 | 6—7 | 8.31 | 6—7 |
| 123 | Phelps' Complete Manure for Potatoes, | 12.03 | 4.52 | 3.30—4.12 | 5.88 | 2.39 | 0.42 | 10.16 | 6—8 | 8.27 | 5—6 | 10.16 | 8—10 |
| 150 | Special Favorite, | 16.82 | 1.80 | 1.24—2.06 | 7.70 | 3.73 | 1.15 | 12.58 | 11—14 | 11.43 | 10—12 | 1.66 | 1.5—2.5 |

* Sulphate of potash, the source of potash.

## *Agricultural Chemicals.*

### *Muriate of Potash.*

[I. and II. sent on from Amherst, Mass.; III. sent on from Concord, Mass.; IV. and V. sent on from Eastham, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., . . . | 0.43 | 1.90 | 0.64 | 2.97 | 2.10 |
| Potassium oxide, . . . | 50.97 | 49.20 | 49.68 | 47.24 | 49.20 |
| Chlorine, . . . . . . | 48.64 | 53.00 | 50.00 | 38.83 | 44.85 |
| Insoluble matter, . . . | 0.11 | 0.11 | Trace. | 0.54 | 0.42 |

[I. and II., sulphate of potash and magnesia, sent on from Amherst, Mass.; III., sulphate of potash, sent on from Eastham; IV., sulphate of potash, sent on from Feeding Hills.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., . . . . . | 14.70 | 17.35 | 8.26 | 2.54 |
| Magnesium oxide, . . . . . | 6.97 | 7.02 | – | 10.88 |
| Potassium oxide, . . . . . . | 16.96 | 29.48 | 26.60 | 24.90 |
| Sulphuric acid, . . . . . . | 32.97 | 40.68 | 41.96 | 48.32 |
| Insoluble matter, . . . . . | 2.70 | 1.47 | 0.51 | 2.67 |

### *Nitrate of Soda.*

[I. and II. sent on from Amherst; III. sent on from Eastham; IV. sent on from Concord.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., . . . . . | 1.74 | 1.50 | 6.62 | 1.30 |
| Sodium oxide, . . . . . . . | 38.14 | 33.63 | 44.96 | – |
| Nitrogen, . . . . . . . . | 14.44 | 15.46 | 14.92 | 15.48 |
| Insoluble matter, . . . . . . | Trace. | 0.10 | None. | Trace. |

*Agricultural Chemicals* — Concluded.

*Sulphate of Ammonia.*

[Two samples from Amherst.]

| | Per Cent. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 2.46 | 2.21 |
| Nitrogen, | 20.14 | 21.30 |
| Sulphuric acid, | 60.05 | 59.37 |
| Insoluble matter, | 0.06 | Trace. |

## 5. *Analyses of Commercial Fertilizers and Manurial Substances sent on for Examination.*

*Wood Ashes.*

[I., II. and III. sent on by Geo. A. Tapley, Revere, Mass.; IV. sent on by Coolidge Bros., South Sudbury, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 18.74 | 12.25 | 4.08 | 2.92 |
| Calcium oxide, | 28.24 | 5.08 | 25.63 | 37.10 |
| Magnesium oxide, | 4.64 | 0.27 | 5.64 | 6.45 |
| Ferric oxide, | 1.10 | 12.36 | 1.18 | 1.77 |
| Potassium oxide, | 5.94 | 2.24 | 5.34 | 5.42 |
| Phosphoric acid, | 2.11 | 0.46 | 2.92 | 2.05 |
| Insoluble matter (before calcination), | 10.52 | 58.45 | 13.69 | 15.37 |
| Insoluble matter (after calcination), | 8.31 | 55.19 | 12.11 | 13.11 |

5. *Analyses, etc.* — Continued.

*Wood Ashes (Four Samples).*

[Sent on by Coolidge Bros., South Sudbury, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 1.59 | 1.88 | 1.66 | 1.98 |
| Calcium oxide, | 41.60 | 39.89 | 43.09 | 40.39 |
| Magnesium oxide. | 3.00 | 4.41 | 2.33 | 3.85 |
| Ferric oxide,. | 0.84 | 1.07 | 0.69 | 0.97 |
| Potassium oxide, | 6.96 | 6.08 | 5.44 | 5.18 |
| Phosphoric acid, | 1.23 | 2.06 | 1.17 | 1.71 |
| Insoluble matter (before calcination), | 11.65 | 15.87 | 9.03 | 12.17 |
| Insoluble matter (after calcination), | 11.07 | 12.96 | 7.91 | 10.26 |

*Wood Ashes.*

[I. sent on by H. G. Herrick, Lawrence, Mass.; II. sent on by James Logan, Worcester, Mass.; III. sent on by Frank Wheeler, Concord, Mass.; IV. sent on by Anson Wheeler, Concord, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C, | 9.12 | 0.18 | 15.60 | 18.51 |
| Calcium oxide, | 31.63 | 39.39 | 32.86 | 31.07 |
| Magnesium oxide, | 3.34 | 3.12 | 3.81 | 2.69 |
| Ferric oxide,. | 1.07 | – | – | – |
| Potassium oxide, | 5.88 | 7.28 | 5.11 | 5.84 |
| Phosphoric acid, | 2.97 | 2.10 | 1.48 | 2.00 |
| Insoluble matter (before calcination), | 18.79 | 12.80 | 16.59 | 8.67 |
| Insoluble matter (after calcination), | 12.67 | 11.94 | 15.68 | 6.52 |

5. *Analyses, etc.* — Continued.

*Wood Ashes*

[I. from Experiment Station, Amherst, Mass.; II. sent on by C. L. Hartshorn, Worcester, Mass.; III. sent on by L. F. Priest, Rock Bottom, Mass.; IV. sent on by H. F. Cross, Hingham, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 15.07 | 0.42 | 15.70 | 4.26 |
| Calcium oxide, | 31.09 | 28.34 | 34.07 | 20.05 |
| Magnesium oxide, | 3.34 | 2.99 | 3.57 | 6.36 |
| Ferric oxide, | – | – | – | – |
| Potassium oxide, | 5.29 | 8.72 | 4.64 | 4.68 |
| Phosphoric acid, | 1.37 | 0.71 | 1.36 | 2.88 |
| Insoluble matter (before calcination), | 13.20 | 52.73 | 12.56 | 42.30 |
| Insoluble matter (after calcination), | 10.22 | 27.73 | 11.10 | 39.98 |

*Wood Ashes.*

[I. and II. sent on by W. L. Hubbard, Sunderland, Mass.; III. sent on by W. L. Faxon, Quincy, Mass.; IV. sent on by F. H. Williams, Sunderland, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 22.29 | 20.91 | 4.73 | 16.54 |
| Calcium oxide, | 32.32 | 29.97 | 32.94 | 32.74 |
| Magnesium oxide, | 3.14 | 3.04 | 4.43 | 3.01 |
| Ferric oxide, | 1.05 | 1.24 | 1.24 | 0.37 |
| Potassium oxide, | 4.27 | 5.64 | 6.79 | 6.56 |
| Phosphoric acid, | 1.47 | 1.32 | 1.79 | 1.43 |
| Insoluble matter (before calcination), | 14.75 | 12.13 | 15.15 | 10.54 |
| Insoluble matter (after calcination), | 11.52 | 10.33 | 13.12 | 8.78 |

5. *Analyses, etc.* — Continued.

*Wood Ashes.*

[I. and II. sent on by C F Clark, Granby, Mass.; III. sent on by L. B. Smith, Eastham, Mass.; IV. sent on by J. D. W. French, North Andover, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 15.37 | 13.17 | 14.08 | 14.52 |
| Calcium oxide, | 35.28 | 32.82 | 35.16 | 34.02 |
| Magnesium oxide, | 3.24 | 3.50 | 2.79 | 3.79 |
| Ferric oxide, | 1.62 | 2.80 | 0.93 | 0.94 |
| Potassium oxide, | 7.73 | 6.86 | 4.16 | 5.88 |
| Phosphoric acid, | 0.78 | 0.79 | 1.69 | 2.37 |
| Insoluble matter (before calcination). | 7.56 | 11.10 | 13.57 | 11.49 |
| Insoluble matter (after calcination), | 6.80 | 8.73 | 11.32 | 9.64 |

*Wood Ashes.*

[I sent on by F. F. O'Neil, North Sudbury, Mass.; II. sent on by Jonathan Ames, South Lincoln, Mass.; III. sent on by F. C. Davis, East Longmeadow, Mass.; IV. sent on by B. W. Brown Concord, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 12.88 | 2.31 | 21.39 | 12.70 |
| Calcium oxide, | 35.41 | 32.82 | 28.01 | 32.67 |
| Magnesium oxide, | 2.75 | 5.34 | 2.86 | 2.64 |
| Ferric oxide, | 1.65 | 1.71 | 1.64 | 1.16 |
| Potassium oxide, | 6.17 | 6.53 | 4.60 | 5.22 |
| Phosphoric acid, | 1.83 | 2.29 | 2.21 | 1.40 |
| Insoluble matter (before calcination), | 12.69 | 20.46 | 13.66 | 24.81 |
| Insoluble matter (after calcination), | 11.60 | 16.20 | 12.37 | 17.41 |

## 5. *Analyses, etc.* — Continued.

### *Wood Ashes.*

[I. sent on by Elijah Bradstreet, Danvers, Mass.; II. sent on by C. W. Copeland, Campello, Mass.; III. sent on by C. E. Adams, South Framingham, Mass.; IV. sent on by Thomas Roche, South Deerfield, Mass.]

| | Per Cent. | | | |
|---|---|---|---|---|
| | I. | II. | III. | IV. |
| Moisture at 100° C., | 12.33 | 10.24 | 11.01 | 23.36 |
| Calcium oxide, | 34.10 | 37.89 | 33.64 | 25.75 |
| Magnesium oxide, | 2.64 | 2.70 | 4.01 | 3.75 |
| Ferric oxide, | 0.98 | 0.85 | 1.30 | – |
| Potassium oxide, | 10.80 | 6.70 | 5.77 | 7.96 |
| Phosphoric acid, | 1.06 | 1.60 | 1.45 | 2.58 |
| Insoluble matter (before calcination), | 20.04 | 9.84 | 16.30 | 14.83 |
| Insoluble matter (after calcination), | 7.54 | 8.54 | 14.60 | 9.36 |

### *Cotton-hull Ashes.*

[Sent on by W. L. Boutwell, Leverett, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 10.35 |
| Calcium oxide, | 19.35 |
| Magnesium oxide, | 10.99 |
| Potassium oxide, | 27.19 |
| Phosphoric acid, | 9.48 |
| Insoluble matter (before calcination), | 13.27 |
| Insoluble matter (after calcination), | 10.86 |

5. *Analyses, etc.* — Continued.

*Saltpetre Waste.*

[I. sent on from the American Powder Mills, Acton, Mass.; II. sent on by Coolidge Bros., South Sudbury, Mass.; III. sent on by L. B. Smith, Barre, Mass.]

| | Per Cent. | | |
|---|---|---|---|
| | I. | II. | III. |
| Moisture at 100° C., | 5.19 | 0.38 | 4.82 |
| Calcium oxide, | 0.47 | 0.84 | 0.85 |
| Magnesium oxide, | 0.27 | 0.05 | 0.25 |
| Sodium oxide, | 36.82 | 49.37 | 50.07 |
| Potassium oxide (4½ cents per pound), | 15.04 | 2.55 | 1.55 |
| Sulphuric acid, | 1.02 | 0.81 | 1.30 |
| Chlorine, | 53.50 | 58.00 | 57.04 |
| Nitrogen (17 cents per pound), | 1.90 | 0.65 | 0.52 |
| Insoluble matter, | Trace. | Trace. | 0.09 |
| Valuation per ton, | $20 00 | $4 11 | $3 17 |

*Refuse from Glue Factory.*

[Sent on by Chas. A. Newhall, Lynn, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 43.06 |
| Organic and volatile matter, | 71.02 |
| Ash, | 28.98 |
| Phosphoric acid, | 0.217 |
| Nitrogen, | 7.82 |
| Insoluble matter, | 18.65 |

5. *Analyses, etc.* — Continued.

### *Fish Chum.*

[Two samples, sent on by L. B. Smith, Eastham, Mass.]

| | Per Cent. | |
|---|---|---|
| | I. | II. |
| Moisture at 100° C., | 11.19 | 14.53 |
| Organic and volatile matter, | 84.94 | 44.35 |
| Total phosphoric acid, | 6.58 | 4.98 |
| Soluble phosphoric acid, | 0.44 | 0.57 |
| Reverted phosphoric acid, | 3.26 | 3.19 |
| Insoluble phosphoric acid, | 2.88 | 1.22 |
| Nitrogen, | 8.14 | 4.70 |
| Insoluble matter, | 1.23 | 29.37 |

### *Dry Ground Fish.*

[I. sent on by S. S. Dwight, Hatfield, Mass.; II. sent on by S. G. Hubbard, Hatfield, Mass.; III. sent on by Thaddeus Graves, Hatfield, Mass.]

| | Per Cent. | | |
|---|---|---|---|
| | I. | II. | III. |
| Moisture at 100° C., | 9.65 | 6.30 | 8.86 |
| Ash, | 22.40 | 20.40 | 17.72 |
| Total phosphoric acid, | 6.88 | 7.25 | 6.97 |
| Soluble phosphoric acid, | 0.49 | 0.52 | 0.49 |
| Reverted phosphoric acid, | 3.06 | 3.89 | 2.04 |
| Insoluble phosphoric acid, | 3.33 | 2.84 | 4.44 |
| Nitrogen, | 9.50 | 6.73 | 7.56 |
| Insoluble matter, | 1.92 | 4.99 | 1.17 |

5. *Analyses, etc.* — Continued.

*Blood, Meat and Bone.*

[Sent on by Isaac Madill, Lexington, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 7.87 |
| Ash, | 20.63 |
| Calcium oxide, | 10.33 |
| Phosphoric acid, | 8.29 |
| Nitrogen, | 5.84 |
| Insoluble matter, | 0.48 |

*Ground Bone.*

[I. sent on by E. H. Smith, Northborough, Mass.; II. sent on by the Hargrave Manufacturing Company, Fall River, Mass.; III. sent on by Anson Wheeler, Concord, Mass.; IV. sent on by A. W. Green, Carlton, Mass ; V. sent on by L. B. Smith, Eastham, Mass.]

*Mechanical Analyses.*

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Fine, smaller than $\frac{1}{50}$ inch, | 36.83 | 46.87 | – | 42.43 | 6.14 |
| Fine medium, smaller than $\frac{1}{25}$ inch, | 36.86 | 37.23 | – | 28.43 | 25.39 |
| Medium, smaller than $\frac{1}{12}$ inch, | 24.58 | 11.80 | – | 21.12 | 28.17 |
| Coarser than $\frac{1}{12}$ inch, | 1.73 | 4.10 | – | 8.02 | 40.30 |
| | 100.00 | 100.00 | – | 100.00 | 100.00 |

*Chemical Analyses.*

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 4.51 | 8.29 | 6.14 | 8.21 | 8.25 |
| Ash, | 56.83 | 67.21 | 50.71 | 62.02 | 57.53 |
| Total phosphoric acid, | 22.69 | 26.72 | 18.17 | 17.67 | 16.84 |
| Soluble phosphoric acid, | 0.14 | 0.34 | 4.14 | 0.56 | 0.14 |
| Reverted phosphoric acid, | 5.70 | 2.78 | 8.77 | 3.61 | 0.35 |
| Insoluble phosphoric acid, | 16.85 | 23.60 | 5.26 | 13.50 | 16.35 |
| Nitrogen, | 3.86 | 2.78 | 2.78 | 2.72 | 3.42 |
| Insoluble matter, | 1.48 | 0.65 | 1.02 | 0.36 | 1.29 |

5. *Analyses, etc.* — Continued.

*Bones boiled in Potash.*

[Sent on from South Framingham, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 10.96 |
| Organic and volatile matter, | 40.52 |
| Total phosphoric acid, | 20.85 |
| Soluble phosphoric acid, | 0.06 |
| Reverted phosphoric acid, | 11.25 |
| Insoluble phosphoric acid, | 9.54 |
| Potassium oxide, | 4.33 |
| Nitrogen, | 2.60 |
| Insoluble matter, | 0.12 |

*Starch Waste.*

[Sent on from Rubber Factory, Hudson, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 10.01 |
| Ash, | 0.23 |
| Nitrogen, | 0.026 |

*"Sludge" from Worcester Sewage Precipitating Tanks.*

[Sent on by J. G. Jefferds, Worcester, Mass.]

| | Per Cent. | |
|---|---|---|
| | As Received. | Dried to 100° C. |
| Moisture at 100° C., | 88.49 | - |
| Organic and volatile matter, | 90.50 | - |
| Calcium oxide, | 1.58 | 16.69 |
| Magnesium oxide, | 0.39 | 4.13 |
| Ferric and aluminic oxides, | 6.22 | 65.36 |
| Potassium oxide, | 0.05 | 0.51 |
| Phosphoric acid, | 0.10 | 1.05 |
| Nitrogen, | 0.05 | 0.54 |
| Insoluble, | 0.93 | 9.76 |
| Valuation per ton, | $0 35 | $3 77 |

## 5. *Analyses, etc.* — Continued.

### *Tankage.*

[Sent on by the Bowker Fertilizer Company, Boston, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 2.17 |
| Total phosphoric acid, | 12.79 |
| Available phosphoric acid, | 6.01 |
| Insoluble phosphoric acid, | 6.78 |
| Fat (ether extract), | 19.19 |

### *Florida Phosphate Rock.*

[I., II. and III. sent on from Boston, Mass.; IV., V. and VI. sent on by Geo. Frost, Mandarin, Fla.; VII. sent on by M. D. Brooks, Fort Meade, Fla.]

| Number. | Moisture at 100° C. | Phosphoric Acid. | Calcium Oxide. | Ferric and Aluminic Oxides. | Insoluble Matter. |
|---|---|---|---|---|---|
| I., | 1.43 | 33.33 | 44.16 | 1.31 | 4.65 |
| II., | 1.18 | 27.07 | 37.57 | 2.59 | 21.96 |
| III., | 5.47 | 6.95 | 12.36 | 4.07 | 53.61 |
| IV., | 1.23 | 18.40 | 17.14 | 6.17 | 54.74 |
| V., | 1.06 | 27.42 | 28.08 | 7.43 | 34.00 |
| VI., | 10.79 | 2.92 | 0.55 | – | 71.32 |
| VII., | 13.62 | 22.42 | 28.06 | 9.46 | 23.30 |

### *Phosphatic Fertilizers.*

[I., plain superphosphate, sent on by Anson Wheeler, Concord, Mass.; II., dissolved bone-black, sent on by Anson Wheeler, Concord, Mass.; III., dissolved bone-black, sent on from Amherst, Mass.; IV., acid phosphate, sent on by L. B. Smith, Eastham, Mass.; V., German phosphatic slag, sent on from Amherst, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., | 10.43 | 10.26 | 20.07 | 10.39 | 0.47 |
| Total phosphoric acid, | 16.55 | 16.77 | 17.35 | 13.45 | 19.04 |
| Soluble phosphoric acid, | 10.87 | 13.92 | 14.80 | 10.17 | – |
| Reverted phosphoric acid, | 1.92 | 1.29 | 2.28 | 2.26 | – |
| Insoluble phosphoric acid, | 3.76 | 1.56 | 0.27 | 1.02 | – |
| Calcium oxide, | Not | determ | ined. | – | 46.47 |
| Insoluble matter, | 7.42 | 4.28 | 2.13 | 10.39 | 4.39 |

5. *Analyses, etc.* — Continued.

## *Hen Manure.*

[Sent on by A. F. Hunter, South Natick, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 58.98 |
| Ash, | 24.75 |
| Calcium oxide, | 1.21 |
| Magnesium oxide, | 0.89 |
| Potassium oxide, | 0.32 |
| Sulphuric acid ($SO_3$), | 1.24 |
| Phosphoric acid, | 1.00 |
| Nitrogen, | 1.20 |
| Insoluble matter, | 17.69 |

## *Jute Waste.*

[Sent on by J. H. Easterbrook, Dudley, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 13.10 |
| Potassium oxide (4¼ cents per pound), | 0.08 |
| Phosphoric acid (6 cents per pound), | 0.72 |
| Nitrogen (10 cents per pound), | 1.50 |
| Valuation per ton, | $3 93 |

## *Shelled Corn, damaged by Fire and Water.*

[Sent on by Chas. I. Pierce, West Northfield, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 21.40 |
| Dry matter, | 78.60 |
| | 100.00 |

*Analysis of Dry Matter.*

| | |
|---|---|
| Crude ash, | 1.54 |
| " cellulose, | 2.78 |
| " fat, | 4.96 |
| " protein (nitrogenous matter), | 9.77 |
| Non-nitrogenous extract matter, | 80.95 |
| | 100.00 |

*Fertilizing Constituents of the Above.*

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 21.40 |
| Ash, | 1.21 |
| Phosphoric acid, | 0.48 |
| Potassium oxide, | 0.28 |
| Nitrogen, | 1.06 |
| Insoluble matter, | 0.10 |
| Valuation per ton, | $4 52 |

5. *Analyses, etc.* — Continued.

### *Buckwheat Hulls.*

[Sent on by E. L. Smith, South Schodack, N. Y.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.900 |
| Calcium oxide, | 0.247 |
| Magnesium oxide, | 0.236 |
| Ferric oxide, | 0.020 |
| Potassium oxide, | 0.521 |
| Phosphoric acid, | 0.073 |
| Nitrogen, | 0.490 |
| Insoluble matter, | 0.066 |

### *Sea Weed.*

[Sent on by D. C. Potter, Fairhaven, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 16.260 |
| Calcium oxide, | 2.061 |
| Magnesium oxide, | 1.175 |
| Sodium oxide, | 3.529 |
| Potassium oxide, | 0.785 |
| Phosphoric acid, | 0.191 |
| Nitrogen, | 4.250 |
| Insoluble matter, | 5.525 |

### *Residuum from Soft Coal.*

[Sent on by B. N. Farren, Montague City, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 2.63 |
| Calcium oxide, | 1.38 |
| Magnesium oxide, | 0.45 |
| Ferric oxide, | 6.02 |
| Aluminic oxide, | 2.71 |
| Potassium oxide, | 0.20 |
| Phosphoric acid, | 0.47 |
| Insoluble matter (before calcination), | 88.09 |
| Insoluble matter (after calcination), | 72.38 |

5. *Analyses, etc.* — Continued.

### "*Vegetable Ivory.*"

[Sent on by Moses Field, Longmeadow, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 8.140 |
| Organic and volatile matter, | 93.580 |
| Ash, | 6.420 |
| Calcium oxide, | 4.842 |
| Magnesium oxide, | 0.430 |
| Ferric oxide, | 0.043 |
| Sodium oxide, | 0.125 |
| Potassium oxide, | 0.461 |
| Phosphoric acid, | 0.237 |
| Nitrogen, | 0.500 |
| Silicic acid, | 0.033 |
| Insoluble matter, | 0.196 |

### *Concentrated Flower Food.*

[Sent on from Springfield, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 11.20 |
| Ash, | 42.89 |
| Phosphoric acid, | 5.30 |
| Lime, | 6.18 |
| Sulphuric acid, | 15.73 |
| Potassium oxide, | 4.72 |
| Sodium oxide, | 17.45 |
| Nitrogen in organic matter, | 2.31 |
| Nitrogen in nitrates, | 4.66 |
| Insoluble matter, | 0.25 |

### "*Flora Vita.*"

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 85.30 |
| Solids, | 14.70 |
| Ferric and aluminic oxides, | 0.65 |
| Calcium oxide, | 0.72 |
| Magnesium oxide, | 0.17 |
| Potassium oxide, | 4.16 |
| Sodium oxide, | 2.48 |
| Phosphoric acid, | 2.80 |
| Sulphuric acid, | 0.84 |
| Chlorine, | 0.06 |
| Nitrogen, | 2.61 |

5. *Analyses, etc.* — Concluded.

*Compound Fertilizers.*

[I. sent on by C. A. Bartlett, Worcester, Mass ; II. sent on by Ebed L. Ripley, Hingham, Mass.; III. sent on by A. L. Ames, Peabody, Mass.; IV. and V. sent on by A. E. Belden, North Hadley, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., . . . . | 3.54 | 4.41 | 10.70 | 14.29 | 9.26 |
| Ash, . . . . . . . . | 37.69 | 34.28 | – | 56.28 | 50.07 |
| Total phosphoric acid, . . | 14.12 | 14.70 | 10.55 | 12.04 | 7.39 |
| Soluble phosphoric acid, . . | 1.41 | 0.58 | 5.69 | 7.27 | 5.27 |
| Reverted phosphoric acid, . | 7.46 | 6.84 | 3.66 | 3.41 | 0.24 |
| Insoluble phosphoric acid, . | 5.25 | 7.28 | 1.20 | 1.36 | 1.88 |
| Potassium oxide, . . . . | 0.07 | 0.46 | 0.96 | 4.39 | 7.30 |
| Nitrogen, . . . . . . | 4.84 | 6.18 | 3.77 | 4.58 | 5.10 |
| Insoluble matter, . . . . | 0.55 | 0.49 | 1.29 | 0.72 | 0.82 |

*Compound Fertilizers.*

[I. sent on by J. M. Butman, Lowell, Mass.; II. sent on by Joseph Breck & Sons, Boston, Mass.; III. sent on by A. F. Crocker, North Amherst, Mass.; IV. and V. sent on by L. B. Smith, Eastham, Mass.]

| | Per Cent. | | | | |
|---|---|---|---|---|---|
| | I. | II. | III. | IV. | V. |
| Moisture at 100° C., . . . . | 8.99 | 11.01 | 9.16 | 11.51 | 15.81 |
| Ash, . . . . . . . . | 51.46 | 71.33 | 61.27 | 84.53 | 72.59 |
| Total phosphoric acid, . . | 14.57 | 8.47 | 14.89 | 0.67 | 10.23 |
| Soluble phosphoric acid, . . | 6.54 | 2.64 | 5.38 | – | 4.54 |
| Reverted phosphoric acid, . | 5.83 | 4.38 | 3.78 | 0.50 | 4.32 |
| Insoluble phosphoric acid, . | 2.20 | 1.45 | 5.73 | 0.17 | 1.37 |
| Potassium oxide, . . . . | 2.26 | 3.81 | 3.24 | 9.67 | 3.71 |
| Nitrogen, . . . . . . | 3.07 | 3.88 | 2.30 | 4.30 | 1.84 |
| Insoluble matter, . . . . | 0.83 | 4.31 | 4.90 | 1.74 | 7.41 |

## *Methods of Fertilizer Analysis.*

*Preparation of Sample.* — The entire available sample is spread upon a smooth, hard surface, and intimately mixed without grinding, all lumps being broken up with a spatula. Unnecessary loss or gain of moisture is to be avoided. *Moisture:* dry 2 grams in the air-bath at 100 to 110° C. to a constant weight.

*1. Total Phosphoric Acid.* — Weigh out 2 grams in a platinum crucible, and destroy the organic matter by carefully burning in a muffle. Weigh when cool, to determine the "organic and volatile matter." Digest the crucible and contents with dilute hydrochloric acid, until the solution of the latter is complete. Filter, and evaporate the filtrate to complete dryness. The "insoluble matter" on the filter is burned and weighed. The residue left from the evaporation is taken up with dilute nitric acid, if the molybdic method is to be followed, but with hydrochloric acid if method (2) is preferred. The solution after filtering is made up to a volume of 200 cubic centimetres with distilled water.

(1) The molybdic method: 25 cubic centimetres of the solution are digested in a water-bath at 65° C. from one to two hours, with an excess of molybdic solution. The precipitate is brought upon a filter, and washed with water containing a little molybdic solution. It is then dissolved in ammonia water, the solution nearly neutralized with hydrochloric acid, and magnesia mixture added slowly, with constant stirring. The precipitate is allowed to stand at least three hours, when it is filtered through a Gooch crucible, washed with dilute ammonia, ignited and weighed.

(2) The following method is occasionally employed when phosphates of iron and alumina are present in small quantities only: To 50 cubic centimetres of the hydrochloric acid solution add ammonia in slight excess. After standing a few minutes, acidify with acetic acid, and filter off the phosphates of iron and alumina, washing carefully with water. To the filtrate add sufficient oxalate of ammonia to precipitate all the lime; digest for several hours at a temperature below boiling, and filter through double filters which have

previously been washed with oxalate of ammonia, washing thoroughly with water. Dissolve the phosphates of iron and alumina on the filter with warm dilute hydrochloric acid, and wash into a beaker containing a small quantity of powdered tartaric acid. When the latter has gone into solution, mix with the filtrate from the oxalate of ammonia. The phosphoric acid is precipitated with magnesia mixture, and treated as in (1).

Soluble phosphoric acid: Weigh out 2 grams into a beaker, cover with 10 to 15 cubic centimetres of water, and allow it to stand for fifteen minutes, stirring three times at equal intervals. Decant the solution through a filter into a graduated cylinder. Add another like quantity of water, and let it stand fifteen minutes more, stirring as before. Filter the solution into the cylinder, and wash the residue on the filter until the filtrate amounts to 200 cubic centimetres. The phosphoric acid is determined in an aliquot part of the solution as under total phosphoric acid.

Insoluble phosphoric acid: Add 100 cubic centimetres of neutral ammonia citrate (sp. gr. 1.09) to the beaker in which the digestion with water has been made. Put in a water-bath and heat to 65° C. Drop in the filter containing the residue from the above operation, and digest for thirty minutes, stirring every five minutes. Filter and wash thoroughly, using the suction pump. Dry, and burn. The ash is then treated as under total phosphoric acid.

Reverted phosphoric acid: The sum of the soluble and insoluble subtracted from the total gives the reverted or citrate-soluble phosphoric acid.

Reagents: The reagents used in the estimation of phosphoric acid are prepared according to directions given in the "Proceedings of the Association of Official Agricultural Chemists," 1889, pages 225 and 226.

For ammonium citrate, 370 grams of citric acid are dissolved in 1,500 cubic centimetres of water, nearly neutralized with crushed carbonate of ammonia, heated to expel carbonic acid, exactly neutralized with ammonia, and brought to a specific gravity of 1.09.

The molybdic solution is prepared by dissolving 100 grams of molybdic acid in 417 cubic centimetres of ammonia of

specific gravity .96. Pour this solution into 1,250 cubic centimetres of nitric acid of specific gravity 1.20, and set in a warm place for several days, or until a portion heated to 40° C. deposits no yellow precipitate.

The magnesia mixture is prepared by dissolving 110 grams of crystallized magnesium chloride and 280 grams of ammonium chloride in 700 cubic centimetres of ammonia of specific gravity .96, and bringing to a volume of two liters.

*2. Methods of Determining Nitrogen.* — The Kjeldahl and soda-lime methods recommended by the Association of Official Agricultural Chemists, in their "Proceedings," 1889, pages 218 to 221, are employed, with occasional control analyses by the absolute cupric oxide mode.

*3. Method for Determining Potash.* — Weigh out two grams of the material in a platinum crucible, and char thoroughly at a temperature just below red heat. Digest for several hours with very dilute hydrochloric acid, on the water-bath. Filter into a graduated cylinder, and make up to 200 cubic centimetres. Take 50 cubic centimetres for each test. Warm, and add, in small quantities at a time, an excess of barium hydrate. Digest for one or two hours at a temperature of 70 to 90° C., filter, washing carefully, and add to the filtrate a few drops of ammonium hydrate, and enough ammonium carbonate to precipitate the excess of barium hydrate. Filter, and bring the filtrate to dryness on the water-bath in a platinum dish. Heat carefully in the covered platinum dish at a temperature just below red heat, until compounds of ammonia cease to come off. Take up the residue in water, filtering if necessary, and add an excess of platinum tetrachloride. Evaporate to dryness on the water-bath, add a small quantity of 80 per cent. alcohol, and allow it to stand for a few hours. Filter through a Gooch crucible, washing with alcohol, dry, and weigh; or filter through paper, wash as before, dry, and brush the potassium platinic chloride upon a weighed watch glass, with a camel's-hair brush, and weigh. If very impure, the double salt is washed with the strong solution of ammonium chloride, saturated with potassium platinic chloride, as recommended in the "Proceedings of the Association of Official Agricultural Chemists," 1889, page 223.

## 6. *Miscellaneous Analyses.*
### (*Insecticides*).

### *Paris Green.*

[Sent on from Amherst, Mass.]

| | Per Cent. I. | Per Cent. II. |
|---|---|---|
| Moisture at 100° C., | 1.34 | 1.31 |
| Copper oxide, | 33.35 | 33.45 |
| Arsenious oxide, | 61.25 | 61.21 |
| Insoluble matter, | 0.13 | 0.09 |
| Acetic acid, | 3.93 | 3.94 |
| | 100.00 | 100.00 |

### *Sulphatine.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 1.40 |
| Calcium oxide, | 18.60 |
| Copper oxide, | 2.61 |
| Sulphuric acid, | 4.73 |
| Sulphur, | 48.28 |
| Insoluble matter, | 1.63 |

### *Death to Rose Bugs.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 2.95 |
| Ash, | 54.14 |
| Calcium oxide, | 17.76 |
| Copper oxide, | 1.05 |
| Sulphuric acid, | 4.35 |
| Sulphur, | 34.53 |
| Insoluble matter, | 0.49 |

## 6. *Miscellaneous Analyses* — Concluded.

### *Prof. De Graff's Bug Destroyer.*

[Sent on from Amherst, Mass.]

| | Per Cent. |
|---|---|
| Moisture at 100° C., | 95.811 |
| Residue from evaporation, | 4.189 |
| Mercury, | 0.782 |
| Chlorine, | 0.265 |
| Sulphuric acid, | 0.484 |
| Aluminic oxide, | 0.904 |
| Potassium oxide, | 0.267 |

### *Tobacco Liquor.*

[I. sent on by Franklin Crocker, Hyannis, Mass.; II. made at station: 6 pounds of stems treated for two days with warm water gave 13.5 ounces liquor.]

| | Per Cent | |
|---|---|---|
| | I. | II. |
| Specific gravity, | 1.3858 | 1.3777 |
| Moisture at 100° C., | 37.710 | 40.890 |
| Ash, | 19.420 | 27.770 |
| Nitrogen, total, | 2.010 | 1.730 |
| Nitrogen as nitrates, | 0.170 | – |
| Nicotine, | 2.115 | 0.530 |
| Ferric and aluminic oxides, | 0.229 | 0.017 |
| Calcium oxide, | 3.069 | 1.466 |
| Magnesium oxide, | 2.303 | 1.121 |
| Phosphoric acid, | 0.404 | 0.057 |
| Sodium oxide, | 0.207 | 0.525 |
| Potassium oxide, | 6.550 | 16.340 |
| Insoluble matter, | Trace. | – |

## II. Analyses of Water sent on for Examination.

[Parts per million.]

| Number. | Actual Ammonia. | Albuminoid Ammonia. | Chlorine. | Solids at 100° C. | Solids at Red Heat. | Hardness (Clark's Degree). | Lead. | Locality. |
|---|---|---|---|---|---|---|---|---|
| 1, | .06 | .120 | 3.00 | 32.00 | 24.00 | 1.95 | - | Amherst. |
| 2, | .02 | .140 | 6.00 | 90.00 | 58.00 | 2.60 | None. | Amherst. |
| 3, | .02 | .040 | Trace. | 44.00 | 20.00 | .79 | None. | Rutland. |
| 4, | None. | .03 | 52.00 | 194.00 | 70.00 | 3.51 | None. | North Hadley. |
| 5, | .02 | .03 | 14.00 | 170.00 | 90.00 | 8 14 | None. | Southbridge. |
| 6, | .016 | .070 | 32.00 | 224.00 | 84.00 | 2.60 | None. | Amherst. |
| 7, | .60 | .12 | 10.00 | 58.00 | 16.00 | 1.69 | None. | Gilbertville. |
| 8, | .02 | .04 | 16.00 | 162.00 | 76.00 | 3.25 | None. | Northborough. |
| 9, | .02 | .03 | 8.00 | 96.00 | 16.00 | 1.27 | None. | Amherst. |
| 10, | .20 | .04 | 12.00 | 92.00 | 48.00 | 1.95 | None. | Gilbertville. |
| 11, | .18 | .04 | 12.00 | 74.00 | 40.00 | 1.95 | None. | Gilbertville. |
| 12, | .08 | .12 | 24.00 | 130.00 | 62.00 | 3.51 | - | Foxborough. |
| 13, | Trace. | .04 | 16.00 | 102.00 | 46.00 | 3.25 | None. | Southbridge. |
| 14, | .20 | .18 | 32.00 | 378.00 | 150.00 | - | - | Amherst. |
| 15, | .01 | .07 | Trace. | 82.00 | 14.00 | .79 | - | Westhampton. |
| 16, | .03 | .14 | Trace. | 60.00 | 8.00 | .63 | None. | West Farms. |
| 17, | .16 | .06 | 20.00 | 160.00 | 30.00 | 2.99 | - | North Amherst. |
| 18, | .16 | .32 | 6.00 | 134.00 | 36.00 | 1.27 | - | South Gardner. |
| 19, | .25 | .30 | 4.00 | - | - | - | - | Amherst. |
| 20, | .08 | .06 | 10.00 | 320.00 | 210.00 | 11.35 | - | Rome, N. Y. |
| 21, | None. | .08 | 16.00 | 168.00 | 28.00 | 2.60 | - | North Amherst. |
| 22, | .04 | .20 | 18.00 | 178.00 | 98.00 | 3.77 | None. | Amherst. |
| 23, | Trace. | .04 | 14.00 | 102 00 | 92.00 | 1.56 | Present. | Amherst. |
| 24, | .02 | .48 | 6.00 | 110.00 | 10.00 | 2.99 | - | Northborough. |
| 25, | .06 | .10 | 22.00 | 274 00 | 104.00 | 6.71 | None. | South Deerfield. |
| 26, | Trace. | .04 | 10.00 | 160.00 | 40.00 | 2.86 | - | Amherst. |
| 27, | .13 | .12 | 8.00 | 144.00 | 44.00 | 1.43 | None. | Ashby. |
| 28, | .03 | .04 | 8.00 | 124.00 | 24.00 | 4.16 | None. | Sunderland. |
| 29, | Trace. | .02 | 28.00 | 144.00 | 14.00 | 5.00 | Present. | Amherst. |

*Analyses of Water* — Continued.

| NUMBER. | Actual Ammonia. | Albuminoid Ammonia. | Chlorine. | Solids at 100° C. | Solids at Red Heat. | Hardness (Clark's Degree). | Lead. | Locality. |
|---|---|---|---|---|---|---|---|---|
| 30, | None. | .05 | 20.00 | 180.00 | 60.00 | 3.38 | None. | Roxbury. |
| 31, | Trace. | .24 | 10.00 | 210.00 | 60.00 | 4.71 | - | Sunderland. |
| 32, | .24 | 15.36 | 12.00 | 64.00 | 20.00 | 1.95 | - | Sunderland. |
| 33, | .04 | .20 | 8.00 | 110.00 | 14.00 | 2.08 | - | Amherst. |
| 34, | None. | .04 | 12.00 | 170.00 | 70.00 | 3.77 | None. | Amherst. |
| 35, | .01 | .05 | 6.00 | 152.00 | 30.00 | 8.14 | None. | South Amherst. |
| 36, | .72 | .56 | 6.00 | 154.00 | 76.00 | 3.51 | - | Littleton. |
| 37, | None. | .036 | 6.00 | 62.00 | 40.00 | 2.08 | Present. | Amherst. |
| 38, | .01 | .135 | 34.00 | 202.00 | 100.00 | 2.73 | - | Eastham. |
| 39, | .06 | .628 | 10.00 | 124.00 | 98.00 | 3.25 | - | Amherst. |
| 40, | 1.12 | 3.84 | 28.00 | 450.00 | 216.00 | 6.86 | None. | Amherst. |
| 41, | .04 | .104 | 14.00 | 180.00 | 54.00 | 3.25 | None. | Amherst. |
| 42, | .072 | .10 | 8.00 | 126.00 | 90.00 | 3.25 | None. | Sunderland. |
| 43, | .276 | .172 | 4.00 | 60.00 | 38.00 | 2.60 | - | North Amherst. |
| 44, | .128 | .196 | 16.00 | 150.00 | 74.00 | 1.69 | None. | Westford. |
| 45, | .104 | .152 | 4.00 | 34.00 | 16.00 | .32 | Present. | Westford. |
| 46, | .10 | .112 | 68.00 | 392.00 | 122.00 | 5.71 | None. | Westford. |
| 47, | .084 | .128 | 16.00 | 150.00 | 44.00 | 1.69 | None. | Westford. |
| 48, | .08 | .196 | 70.00 | 420.00 | 164.00 | 6.00 | None. | Acton. |
| 49, | .068 | .120 | 22.00 | 124.00 | 54.00 | 1.27 | - | Gloucester. |
| 50, | .37 | .21 | 12.00 | 58.00 | 28.00 | 1.95 | None. | Weston. |
| 51, | .022 | .068 | 20.00 | 204.00 | 120.00 | 3.90 | None. | Amherst. |
| 52, | 1.55 | .40 | 32.00 | 314.00 | 118.00 | 3.90 | Present. | Amherst. |
| 53, | .064 | .176 | 60.00 | 352.00 | 158.00 | 3.51 | Present. | Amherst. |
| 54, | .140 | .180 | 76.00 | 458.00 | 150.00 | 9.57 | Present. | Acton. |
| 55, | .088 | .080 | 12.00 | 92.00 | 78.00 | 1.95 | None. | Barre Plains. |
| 56, | .060 | .044 | 16.00 | 156.00 | 56.00 | 2.60 | None. | Barre Plains. |
| 57, | .084 | .092 | Trace. | 62.00 | 44.00 | .48 | None. | Brookline. |
| 58, | .076 | .108 | 4.00 | 32.00 | 20.00 | .32 | None. | Brookline. |
| 59, | .100 | .248 | 36.00 | 110.00 | 10.00 | 1.95 | None. | Brookline. |

*Analyses of Water* — Concluded.

| Number. | Actual Ammonia. | Albuminoid Ammonia. | Chlorine. | Solids at 100° C. | Solids at Red Heat. | Hardness (Clark's Degree). | Lead. | Locality. |
|---|---|---|---|---|---|---|---|---|
| 60, | .08 | .226 | 14.00 | 106.00 | 40.00 | 2.47 | None. | Leverett. |
| 61, | Trace. | .016 | Trace. | 88.00 | 18.00 | 3.25 | None. | Shutesbury. |
| 62, | .052 | .052 | 340.00 | 844.00 | 664.00 | 3.25 | None. | Clifton. |
| 63, | .188 | .176 | 8.00 | 126.00 | 82.00 | 2.60 | Present. | Bedford. |
| 64, | .140 | .180 | 32.00 | 560.00 | 460.00 | 6.71 | None. | Bedford. |
| 65, | .088 | .116 | 24.00 | 320.00 | 220.00 | 3.64 | None. | Bedford. |

The analyses have been made according to Wancklyn's process, familiar to chemists, and are directed towards the indication of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wancklyn and E. T. Chapman.)

Mr. Wancklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (=71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

* One gallon equals 70,000 grains.

5. Albuminoid ammonia, over .15 parts per million, ought to absolutely condemn a water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the previously stated results of analyses indicate that Nos. 7, 10, 11, 14, 17, 18, 19, 23, 27, 29, 32, 36, 37, 40, 43, 44, 45, 46, 50, 52, 54, 59, 63 and 64 ought to be condemned as unfit for family use, while Nos. 12, 20, 25, 33, 39, 42, 47, 48, 49, 53, 55, 56, 58, 60 and 65 must be considered suspicious. From this record it will be seen that over one-third of the entire number of well waters tried proved unfit for drinking. Heating well waters to the boiling point removes, not unfrequently, immediate danger. Eight samples gave unmistakable evidence of the presence of lead.

Parties sending on water for analysis ought to be very careful to use clean vessels, clean stoppers, etc. The samples should be sent on without delay after collecting. One gallon is desirable for the analysis.

# Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.

Prepared by W. H. Beal.

[As the basis of valuation changes from year to year, no valuation is stated.]

## 1868-1891.

This compilation does not include the analyses made of licensed fertilizers. They are to be found in the reports of the State Inspector of Fertilizers from 1873 to 1890, contained in the reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

| | Analyses. | Moisture. | Ash. | Nitrogen. | | | Potash. | | | Total Phosphoric Acid. | | | Soluble Phosphoric Acid. | Reverted Phosphoric Acid. | Insoluble Phosphoric Acid. | Soda. | Lime. | Magnesia. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | Maximum. | Minimum. | Average. | | | | | | | | | | | |
| *1. Chemicals, Refuse Salts, Ashes, etc.* | | | | | | | | | | | | | | | | | | | | | | | |
| Muriate of potash, . . . . . . . | 54 | 2.00 | - | - | - | - | 58.98 | 45.94 | **51.80** | - | - | - | - | - | - | 6.69 | - | .55 | - | - | - | 48.60 | .75 |
| Sulphate of potash, . . . . . . . | 19 | 2.50 | - | - | - | - | 51.28 | 21.36 | **33.60** | - | - | - | - | - | - | 4.46 | - | 1.50 | - | 45.72 | - | - | .75 |
| Sulphate of potash and magnesia, . . | 15 | 4.75 | - | - | - | - | 29.48 | 16.96 | **23.50** | - | - | - | - | - | - | 6.25 | 2.57 | - | - | 44.25 | - | 2.60 | 1.41 |
| Kainite, . . . . . . . . . . | 4 | 3.20 | - | - | - | - | 16.48 | 12.51 | **13.54** | - | - | - | - | - | - | 18.97 | 1.15 | 9.80 | - | 20.55 | - | 33.25 | 2.13 |
| Carnallite, . . . . . . . . . | 1 | - | - | - | - | - | - | - | **13.68** | - | - | - | - | - | - | 7.66 | - | 13.19 | - | .56 | - | 41.56 | - |
| Krugite, . . . . . . . . . . | 1 | 4.82 | - | - | - | - | - | - | **8.42** | - | - | - | - | - | - | 5.57 | 12.45 | 8.79 | - | 31.94 | - | 6.63 | 14.96 |
| Sulphate of magnesia (*Kieserite*), . . | 9 | 22.20 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 2.82 | 17.30 | - | 36.10 | - | - | 5.73 |
| Nitrate of potash, . . . . . . . | 2 | 1.93 | - | 14.58 | 11.60 | **13.09** | 45.62 | 44.76 | **45.19** | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Nitrate of soda, . . . . . . . . | 19 | 1.40 | - | 16.01 | 14.44 | **15.75** | - | - | - | - | - | - | - | - | - | 35.25 | - | - | - | - | - | .50 | .50 |
| Sulphate of ammonia, . . . . . . | 24 | 1.00 | - | 21.68 | 19.70 | **20.50** | - | - | - | - | - | - | - | - | - | - | - | - | - | 60.00 | - | - | - |
| Saltpetre waste, . . . . . . . . | 10 | 2.75 | - | 3.30 | .52 | **2.43** | 30.94 | 1.55 | **15.50** | - | - | - | - | - | - | 34.25 | .75 | .19 | - | 1.85 | - | 48.30 | - |
| Nitre salt-cake, . . . . . . . . | 2 | 6.03 | - | - | - | **2.29** | - | - | **.87** | - | - | - | - | - | - | 29.56 | - | - | - | 47.77 | - | - | 3.92 |
| Wood ashes, . . . . . . . . . | 156 | 12.00 | - | - | - | - | 10.80 | 2.93 | **5.25** | 4.61 | .51 | **1.75** | - | - | - | - | 34.80 | 3.25 | .88 | - | - | - | 12.50 |
| Cotton-seed hull ashes, . . . . . . | 21 | 7.33 | - | - | - | - | 42.12 | 17.34 | **23.80** | 13.67 | 2.89 | **8.50** | - | - | - | - | 9.50 | 11.25 | 1.60 | - | - | - | 11.79 |
| Ashes of spent tan-bark, . . . . . | 3 | 3.61 | - | - | - | - | 2.87 | 1.14 | **2.04** | 2.77 | .13 | **1.61** | - | - | - | - | 33.46 | 3.55 | - | - | - | - | 24.33 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Logwood ashes, | 1 | 1.50 | - | - | - | - | - | - | .08 | - | - | 2.30 | - | - | - | - | 3.90 | - | - | - | - | - | 9.70 |
| Hard-pine wood ashes, | 1 | .75 | - | - | - | - | - | - | 10.16 | - | - | 2.24 | - | - | - | - | 24.95 | - | - | - | - | - | 29.90 |
| Mill ashes, | 1 | .53 | - | - | - | - | - | - | 1.60 | - | - | .46 | - | - | - | - | 34.93 | 1.35 | - | - | - | - | 36.36 |
| Ashes from blue works, | 1 | 12.74 | 63.78 | - | - | - | - | - | 9.02 | - | - | - | - | - | - | - | - | - | - | - | - | - | 12.30 |
| Sea-weed ashes, | 1 | 1.47 | - | - | - | - | - | - | .92 | - | - | .30 | - | - | - | 8.76 | 6.06 | 4.37 | - | 2.98 | - | 6.60 | 63.65 |
| Nova Scotia plaster, | 10 | 6.50 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 33.85 | .75 | - | 45.75 | - | - | 2.50 |
| Onondaga plaster, | 4 | 13.27 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 30.00 | 4.66 | - | 32.50 | 8.20 | - | 9.83 |
| Gas-house lime, | 3 | 22.28 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 43.66 | 8.30 | - | 20.73 | - | - | 6.05 |
| Lime waste from sugar factory, | 1 | 36.30 | - | - | - | - | - | - | .22 | - | - | 2.25 | - | - | - | - | 27.51 | - | - | - | - | - | .32 |
| Lime-kiln ashes, | 7 | 15.45 | - | - | - | - | 1.70 | .02 | .86 | 3.16 | .36 | 1.18 | - | - | - | - | 44.80 | 2.60 | - | - | 17.75 | - | 8.25 |
| Marls (Massachusetts), | 5 | 18.18 | - | - | - | - | - | - | - | 2.72 | .06 | 1.05 | - | - | - | - | 40.07 | .64 | .69 | - | 28.51 | - | 3.44 |
| Marls (Virginia), | 2 | 15.98 | - | - | - | - | .61 | .37 | .49 | .09 | .08 | .09 | - | - | - | - | 7.25 | .21 | - | .66 | 7.25 | - | 64.23 |
| Marl (North Carolina), | 1 | 1.50 | - | - | - | - | - | - | .04 | - | - | .56 | - | - | - | - | 21.95 | .61 | - | - | - | - | 50.18 |
| *II. Guanos, Phosphates, etc.* | | | | | | | | | | | | | | | | | | | | | | | |
| Peruvian guano, | 26 | 14.81 | 37.61 | 13.50 | 4.44 | 7.85 | 4.08 | 1.14 | 2.61 | 20.60 | 5.96 | 15.26 | 4.57 | 3.79 | 6.90 | - | - | - | - | - | - | - | 6.60 |
| Bat guano from Texas, | 9 | 40.09 | 18.24 | 10.51 | 2.58 | 6.47 | - | - | 1.31 | 6.53 | 1.00 | 3.76 | - | - | - | - | - | - | - | - | - | - | 2.00 |
| Cuba guano, | 5 | 24.27 | .67 | 2.74 | .63 | 1.67 | - | - | - | 16.16 | 11.54 | 13.35 | - | - | - | - | - | - | - | - | - | - | 3.17 |
| Caribbean guano (*Orchilla*), | 12 | 7.31 | - | - | - | - | - | - | - | 35.43 | 18.11 | 26.77 | - | - | - | - | 39.95 | 3.29 | - | 2.08 | - | - | 1.27 |
| Mona Island guano, | 1 | 13.32 | - | - | - | .76 | - | - | - | - | - | 21.38 | - | 7.55 | 14.33 | - | 37.49 | - | - | - | - | - | 2.45 |
| South Carolina rock phosphate, | 5 | 1.50 | - | - | - | - | - | - | - | 30.51 | 25.81 | 28.03 | .27 | .33 | 27.69 | - | 41.87 | 3.03 | 4.80 | - | - | - | 9.04 |
| Florida rock phosphate, | 14 | 2.12 | - | - | - | - | - | - | - | 37.27 | 6.95 | 22.19 | - | - | - | - | 23.31 | - | 6.03 | - | - | - | 34.14 |

| | Analyses. | Moisture. | Ash. | Nitrogen. Maximum. | Nitrogen. Minimum. | Nitrogen. Average. | Potash. Maximum. | Potash. Minimum. | Potash. Average. | Total Phosphoric Acid. Maximum. | Total Phosphoric Acid. Minimum. | Total Phosphoric Acid. Average. | Soluble Phosphoric Acid. | Reverted Phosphoric Acid. | Insoluble Phosphoric Acid. | Soda. | Lime. | Magnesia. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *II. Guanos, Phosphates, etc.* — Concluded. | | | | | | | | | | | | | | | | | | | | | | | |
| Navassa phosphate, | 2 | 7.60 | - | - | - | - | - | - | - | 34.45 | 34.09 | 34.27 | - | - | - | - | 37.45 | - | 10.27 | - | - | - | 2.70 |
| Brockville phosphate, | 1 | 2.50 | - | - | - | - | - | - | - | - | - | 35.21 | - | - | - | - | - | - | - | - | - | - | 6.46 |
| Phosphatic slag, | 4 | 1.45 | - | - | - | - | - | - | - | 30.51 | 18.91 | 23.49 | - | 3.06 | 21.65 | - | 48.66 | 3.42 | 10.12 | - | - | - | 9.40 |
| Bone-black, | 5 | 4.60 | - | - | - | - | - | - | - | 30.54 | 16.56 | 28.28 | - | - | - | - | - | - | - | - | - | - | 3.64 |
| South American bone-ash, | 1 | 7.00 | - | - | - | - | - | - | - | - | - | 35.89 | - | - | - | - | 44.89 | - | - | - | - | - | 4.50 |
| *III. Refuse Substances.* | | | | | | | | | | | | | | | | | | | | | | | |
| Dried blood, | 14 | 12.50 | 6.37 | 13.55 | 8.10 | 10.52 | - | - | - | 6.23 | 1.53 | 1.91 | - | - | - | - | - | - | - | - | - | - | - |
| Ammonite, | 1 | 5.88 | - | - | - | 11.33 | - | - | - | - | - | 3.43 | - | - | - | - | - | - | - | - | - | - | 1.38 |
| Oleomargarine refuse, | 1 | 8.54 | 14.42 | - | - | 12.12 | - | - | - | - | - | .88 | - | - | - | - | - | - | - | - | - | - | .96 |
| Felt refuse, | 1 | 29.24 | 33.53 | - | - | 5.26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 8.44 |
| Sponge refuse, | 1 | 7.25 | - | - | - | 2.43 | - | - | - | - | - | 3.19 | - | - | - | - | 3.94 | 1.27 | - | - | - | - | 39.05 |
| Horn and hoof waste, | 3 | 10.17 | 7.63 | 15.49 | 11.84 | 13.25 | - | - | - | 2.30 | 1.36 | 1.83 | - | - | - | - | - | - | - | - | - | - | .24 |
| Raw wool, | 1 | 6.95 | 7.54 | - | - | 12.88 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3.63 |
| Wool waste, | 5 | 9.27 | - | 10.20 | 1.18 | 5.64 | 3.08 | .54 | 1.30 | - | - | .29 | - | - | - | - | .67 | .07 | - | - | - | - | 4.60 |
| Wool washings (water), | 1 | - | - | - | - | - | - | - | 3.92 | - | - | - | - | - | - | .49 | .28 | - | - | - | - | - | - |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wool washings (acid), | 1 | - | - | - | - | - | - | - | 4.20 | - | - | - | - | - | - | .40 | .61 | .20 | - | - | - | - | - |
| Wool washings (alkaline), | 1 | 92.03 | 3.28 | - | - | .09 | - | - | 1.09 | - | - | - | - | - | - | .92 | .04 | - | - | - | - | - | .22 |
| Meat mass, | 5 | 12.09 | 13.60 | 11.50 | 9.69 | 10.44 | - | - | - | 3.58 | .56 | 2.07 | - | - | - | - | - | - | - | - | - | - | .58 |
| Bone soup, | 1 | 82.92 | 7.07 | - | - | 1.14 | - | - | - | - | - | 1.26 | - | - | - | - | - | - | - | - | - | - | - |
| Dried soup from meat and bone, | 1 | 14.80 | 8.40 | - | - | 9.97 | - | - | - | - | - | .53 | - | - | - | - | - | - | - | - | - | - | .64 |
| Dried soup from rendering cattle feet, | 1 | 10.80 | 7.50 | - | - | 14.47 | - | - | - | - | - | .46 | - | - | - | - | - | - | - | - | - | - | .26 |
| Dried soup from horse rendering, | 1 | 92.14 | - | - | - | 1.12 | - | - | - | - | - | .14 | - | - | - | - | - | - | - | - | - | - | - |
| Soap-grease refuse, | 2 | 29.25 | 51.39 | 4.20 | 2.21 | 3.21 | - | - | - | 15.37 | 11.04 | 13.21 | - | - | - | - | - | - | - | - | - | - | 1.29 |
| Bones, | 131 | 7.47 | 56.07 | 4.70 | 1.62 | 4.12 | - | - | - | 32.52 | 18.04 | 23.50 | .43 | 7.85 | 15.22 | - | - | - | - | - | - | - | 1.25 |
| Tankage, | 13 | 13.20 | 28.75 | 8.07 | 4.60 | 6.82 | - | - | - | 16.94 | 8.76 | 11.25 | .27 | 4.75 | 6.23 | - | - | - | - | - | - | - | 1.23 |
| Fish with less than twenty per cent. water, | 55 | 12.75 | 21.50 | 11.40 | 6.81 | 7.25 | - | - | - | 11.26 | 5.50 | 8.25 | .55 | 2.50 | 5.10 | - | - | - | - | - | - | - | 2.20 |
| Fish with between twenty and forty per cent. water, | 9 | 29.34 | 19.14 | 7.41 | 4.22 | 5.81 | - | - | - | 8.32 | 4.68 | 7.25 | .82 | 2.87 | 3.76 | - | - | - | - | - | - | - | 1.85 |
| Fish with more than forty per cent. water, | 10 | 45.46 | 15.50 | 7.60 | 2.43 | 4.97 | - | - | - | 8.56 | 2.94 | 5.08 | 1.17 | 1.33 | 2.58 | - | - | - | - | - | - | - | 1.35 |
| Whale meat, raw, | 1 | 44.50 | 1.04 | - | - | 4.86 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Lobster shells, | 1 | 7.27 | - | - | - | 4.50 | - | - | - | - | - | 3.52 | - | - | - | - | 22.24 | 1.30 | - | - | - | - | .27 |
| Castor-bean pomace, | 4 | 9.98 | 5.70 | 5.72 | 5.33 | 5.56 | 1.70 | .64 | 1.12 | 2.22 | 1.57 | 2.16 | - | - | - | - | .87 | .29 | - | - | - | - | 1.75 |
| Cotton-seed meal, | 10 | 7.75 | 5.77 | 7.26 | 4.02 | 6.66 | 2.09 | .89 | 1.62 | 3.17 | 1.26 | 1.95 | - | - | - | - | .39 | .99 | - | - | - | - | .60 |
| Rotten brewer's grain, | 1 | 78.77 | - | - | - | .72 | - | - | .04 | - | - | .43 | - | - | - | - | .26 | .15 | - | - | - | - | .59 |
| Tobacco stems, | 6 | 10.61 | 14.07 | 2.91 | .90 | 2.29 | 8.82 | 3.76 | 6.44 | 2.09 | .44 | .60 | - | - | - | .34 | 3.89 | 1.23 | - | - | - | - | .82 |
| Cotton waste, wet, | 1 | 34.69 | - | - | - | 1.30 | - | - | .80 | - | - | 1.54 | - | - | - | - | 2.45 | 1.13 | - | - | - | - | 41.33 |
| Cotton waste, dry, | 2 | 6.89 | - | 2.09 | 1.32 | 1.71 | 1.62 | .89 | 1.26 | .84 | .83 | .84 | - | - | - | - | 1.99 | .77 | - | - | - | - | 34.89 |

| | Analyses. | Moisture. | Ash. | Nitrogen. Maximum. | Nitrogen. Minimum. | Nitrogen. Average. | Potash. Maximum. | Potash. Minimum. | Potash. Average. | Total Phosphoric Acid. Maximum. | Total Phosphoric Acid. Minimum. | Total Phosphoric Acid. Average. | Soluble Phosphoric Acid. | Reverted Phosphoric Acid. | Insoluble Phosphoric Acid. | Soda. | Lime. | Magnesia. | Ferric and Aluminic Oxides. | Sulphuric Acid. | Carbonic Acid. | Chlorine. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *III. Refuse Substances* — Concluded. | | | | | | | | | | | | | | | | | | | | | | | |
| Cotton dust, | 1 | 34.46 | 50.93 | - | - | .50 | - | - | .19 | - | - | .21 | - | - | - | - | .90 | .90 | - | - | - | - | 47.46 |
| Glucose refuse, | 1 | 8.10 | - | - | - | 2.62 | - | - | .15 | - | - | .29 | - | - | - | - | .18 | .02 | - | - | - | - | .07 |
| Hop refuse, | 1 | 8.98 | - | - | - | .98 | - | - | .11 | - | - | .20 | - | - | - | - | .27 | .10 | - | - | - | - | .63 |
| Sumac waste, | 1 | 63.06 | 6.80 | - | - | 1.19 | - | - | 3.25 | - | - | - | - | - | - | - | 1.14 | 3.25 | - | - | - | - | 2.25 |
| Eel-grass, | 2 | 35.39 | 15.60 | .96 | .70 | .83 | 1.61 | .21 | .91 | .41 | .22 | .32 | - | - | - | 1.63 | 2.13 | .11 | - | - | - | - | 1.06 |
| Rockweed, green, | 1 | 68.50 | 23.70 | - | - | .62 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Rockweed, dry, | 1 | 10.68 | 35.75 | - | - | 1.45 | - | - | 4.89 | - | - | 2.75 | - | - | - | 7.90 | 7.66 | .21 | - | - | - | - | 10.40 |
| Wet kelp, | 1 | 88.04 | 2.26 | - | - | .26 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Blue-green alga (*Lyngbia majuscula*), dry, | 1 | 16.26 | - | - | - | 4.25 | - | - | .79 | - | - | .19 | - | - | - | 3.53 | 2.06 | 1.18 | - | - | - | - | 5.53 |
| Mussel mud, wet, | 1 | 60.01 | 27.29 | - | - | .21 | - | - | 6.17 | - | - | .10 | - | - | - | .70 | .93 | .14 | 3.48 | - | - | - | - |
| Mussel mud, dry, | 1 | 2.24 | 72.02 | - | - | .72 | - | - | - | - | - | .35 | - | - | - | - | 23.39 | - | 8.26 | - | - | - | 37.60 |
| Salt mud, | 2 | 53.37 | 41.19 | .40 | .39 | .40 | .33 | .32 | .33 | - | - | - | - | - | - | .94 | .91 | .37 | 4.13 | - | - | - | 34.88 |
| Fresh-water mud, | 1 | 40.37 | - | - | - | 1.37 | - | - | .22 | - | - | .26 | - | - | - | - | 1.27 | .29 | 1.80 | - | - | - | 18.26 |
| Muck, | 12 | 55.13 | 13.75 | 2.54 | .26 | 1.12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Peat, | 9 | 61.50 | 7.71 | 1.40 | .41 | .75 | - | - | - | - | - | - | - | - | - | - | .50 | - | - | - | - | - | .38 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Turf, | 1 | 19.29 | 6.36 | 1.97 | 1.91 | 1.94 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Soot, | 1 | 5.54 | 77.10 | - | - | - | - | - | 1.83 | - | - | - | - | - | - | - | - | - | - | - | - | - | 35.34 |
| *IV. Animal Excrement, etc.* | | | | | | | | | | | | | | | | | | | | | | | |
| Barn-yard manure, | 21 | 69.77 | 8.36 | .67 | .26 | .41 | .80 | .13 | .40 | .75 | .13 | .28 | - | - | - | - | .30 | .19 | - | - | - | - | 6.92 |
| Poudrette, dry, | 1 | 5.25 | 35.45 | - | - | 3.58 | - | - | .49 | - | - | 5.74 | - | - | - | - | - | - | - | - | - | - | 4.65 |
| Hen manure, fresh, | 1 | 45.73 | - | - | - | .79 | - | - | .18 | - | - | .47 | - | - | - | - | .97 | - | - | - | - | - | 39.32 |
| Hen manure, dry, | 1 | 8.35 | - | - | - | 2.13 | - | - | 9.94 | - | - | 2.02 | - | - | - | - | 2.22 | .62 | - | - | - | - | 34.64 |

# COMPILATION OF ANALYSES OF FODDER ARTICLES, FRUITS, SUGAR-PRODUCING PLANTS, DAIRY PRODUCTS, ETC.,

MADE AT

AMHERST, MASS.

## 1868-1891.

PREPARED BY W. H. BEAL.

*A.* ANALYSES OF FODDER ARTICLES.

*B.* ANALYSES OF FODDER ARTICLES WITH REFERENCE TO FERTILIZING INGREDIENTS.

*C.* ANALYSES OF FRUIT.

*D.* ANALYSES OF SUGAR-PRODUCING PLANTS.

*E.* DAIRY PRODUCTS.

## A. *Analyses of Fodder Articles.*

| NAME. | Analyses. | Dry Matter. | | | One Hundred Parts of Dry Matter contain — Protein. | | | Fat. | | | Nitrogen — Free Extract. | | | Fibre. | | | Ash. | Nutritive Ratio (Average). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | | |
| *I. Green Fodders.* | | | | | | | | | | | | | | | | | | |
| Fodder corn, | 23 | 30.53 | 10.33 | 19.13 | 17.19 | 8.04 | 10.33 | 6.10 | 1.42 | 2.42 | 63.13 | 42.02 | 55.30 | 31.53 | 19.26 | 25.97 | 5.98 | 1:7.99 |
| Fodder corn (ensilaged), | 26 | 28.59 | 13.12 | 22.03 | 12.58 | 5.98 | 8.11 | 6.49 | 1.82 | 3.84 | 65.69 | 42.99 | 55.79 | 38.92 | 17.67 | 26.88 | 5.38 | 1:10.80 |
| Sorghum, | 6 | 23.18 | 12.38 | 17.41 | 11.84 | 7.46 | 8.74 | 2.00 | 1.21 | 1.55 | 64.93 | 47.65 | 56.15 | 29.27 | 22.00 | 26.73 | 6.83 | 1:11.62 |
| Common millet, | 9 | 49.29 | 21.32 | 35.42 | 12.16 | 5.43 | 7.50 | 3.99 | 2.09 | 2.74 | 58.61 | 46.39 | 53.89 | 33.98 | 24.88 | 30.99 | 4.84 | - |
| Japanese millet ("white head"), | 3 | 26.24 | 20.95 | 24.76 | 10.98 | 7.26 | 8.72 | 2.64 | 1.94 | 2.33 | 50.87 | 46.71 | 49.60 | 38.90 | 30.12 | 34.47 | 4.88 | - |
| Japanese millet ("red head"), | 6 | 33.83 | 22.66 | 27.33 | 7.99 | 4.92 | 6.90 | 2.45 | 1.58 | 2.01 | 60.83 | 50.11 | 52.91 | 35.29 | 25.21 | 32.10 | 6.08 | - |
| White kibi, | 2 | 24.26 | 22.85 | 23.56 | 15.14 | 10.79 | 12.97 | 1.61 | 1.50 | 1.56 | 53.66 | 52.30 | 52.91 | 31.70 | 23.03 | 27.37 | 5.19 | - |
| Mochi millet, | 3 | 42.29 | 30.07 | 37.42 | 11.90 | 6.11 | 9.94 | 1.94 | 1.74 | 1.81 | 67.08 | 49.06 | 55.69 | 29.80 | 20.01 | 25.56 | 7.00 | - |
| Mix, | 3 | 31.36 | 18.17 | 24.45 | 16.70 | 9.81 | 13.53 | 2.48 | 1.35 | 1.86 | 52.30 | 47.75 | 51.27 | 27.44 | 26.82 | 27.06 | 6.28 | - |
| Green oats, | 5 | 28.82 | 15.51 | 20.03 | 20.47 | 7.05 | 13.85 | 3.32 | 2.02 | 2.68 | 50.69 | 40.81 | 45.90 | 33.12 | 25.20 | 29.70 | 7.87 | 1:9.97 |
| Timothy (*Phleum pratense* L.), | 2 | 35.00 | 34.26 | 34.63 | 8.83 | 8.20 | 8.52 | 2.07 | 1.95 | 2.01 | 51.33 | 51.23 | 51.27 | 33.23 | 32.50 | 32.87 | 5.33 | 1:10.96 |
| Hungarian grass (*Setaria Italica* Beauv.), | 1 | - | - | 25.93 | - | - | 9.38 | - | - | 1.01 | - | - | 57.80 | - | - | 24.66 | 7.15 | 1:6.86 |
| Vetch and oats (1 part vetch and 9 parts oats), | 2 | 24.04 | 13.89 | 18.97 | 10.76 | 10.59 | 10.68 | 2.71 | 2.29 | 2.52 | 43.75 | 40.10 | 41.91 | 35.81 | 34.20 | 35.01 | 9.88 | 1:6.85 |
| Horse bean, whole plant (*Vicia faba* L.), | 1 | - | - | 15.17 | - | - | 16.68 | - | - | 2.31 | - | - | 47.09 | - | - | 28.17 | 5.75 | 1:2.71 |
| Soja bean, whole plant (*Soja hispida* Mönch.), | 9 | 36.36 | 18.54 | 23.12 | 22.19 | 14.02 | 16.76 | 8.98 | 2.71 | 4.99 | 47.89 | 40.80 | 44.44 | 31.89 | 21.67 | 25.92 | 7.89 | 1:4.09 |
| Cow-pea vines, | 3 | 21.19 | 18.15 | 19.63 | 17.93 | 11.24 | 14.59 | 2.99 | 1.81 | 2.48 | 60.62 | 46.13 | 52.42 | 25.88 | 21.87 | 23.59 | 6.92 | 1:5.82 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Serradella (*Ornithopus sativus* Brot.), | 2 | 19.42 | 15.40 | 17.41 | 17.75 | 12.17 | 14.96 | 2.65 | 2.09 | 2.37 | 41.54 | 35.45 | 38.49 | 38.76 | 26.21 | 32.49 | 11.69 | 1:4.67 |
| White lupine (*Lupinus albus* L.), | 1 | - | - | 14.65 | - | - | 18.71 | - | - | 2.41 | - | - | 42.67 | - | - | 31.18 | 5.03 | - |
| Spanish moss (*Tillandsia usneoides* L.), | 1 | - | - | 39.20 | - | - | 4.45 | - | - | 2.54 | - | - | 57.73 | - | - | 32.61 | 2.67 | - |
| *II. Hay and Dry Coarse Fodders.* | | | | | | | | | | | | | | | | | | |
| English hay (mixed hays), | 6 | 91.94 | 86.96 | 89.73 | 11.93 | 8.75 | 9.94 | 2.77 | 2.09 | 2.54 | 54.43 | 47.11 | 49.12 | 35.55 | 29.21 | 31.96 | 6.44 | 1:11.33 |
| Rowen of mixed hay, | 4 | 91.16 | 80.29 | 86.10 | 14.70 | 11.63 | 13.45 | 5.03 | 2.60 | 3.91 | 53.52 | 41.92 | 45.48 | 31.50 | 25.11 | 28.88 | 8.28 | 1:6.36 |
| Timothy hay, | 4 | 92.76 | 89.45 | 91.43 | 9.02 | 7.24 | 8.32 | 2.65 | 1.95 | 2.20 | 54.43 | 50.01 | 51.73 | 36.59 | 29.21 | 32.90 | 4.85 | 1:11.44 |
| Red-top hay (*Agrostis vulgaris* With.), | 4 | 93.19 | 91.76 | 92.30 | 8.40 | 6.41 | 7.88 | 1.69 | 1.50 | 1.60 | 54.74 | 50.32 | 52.63 | 34.11 | 31.12 | 32.92 | 4.97 | 1:12.06 |
| Kentucky blue-grass (*Poa pratensis* L.), | 2 | 96.10 | 93.22 | 94.66 | 8.78 | 8.65 | 8.72 | 2.08 | 2.03 | 2.06 | 49.61 | 44.11 | 46.29 | 36.84 | 32.21 | 34.58 | 8.35 | 1:10.38 |
| Orchard grass (*Dactylis glomerata* L.), | 4 | 91.62 | 90.86 | 91.17 | 11.29 | 7.57 | 8.99 | 3.56 | 2.40 | 2.91 | 47.34 | 43.50 | 46.15 | 35.79 | 34.12 | 34.89 | 7.05 | 1:10.47 |
| Meadow fescue (*Festuca pratensis* Huds.), | 5 | 94.70 | 87.84 | 91.09 | 7.85 | 5.89 | 6.76 | 2.17 | 1.65 | 1.87 | 49.18 | 42.03 | 46.31 | 39.90 | 34.61 | 36.93 | 8.13 | 1:13.69 |
| Perennial rye grass (*Lolium perenne* L.), | 4 | 93.64 | 90.50 | 92.60 | 16.56 | 6.59 | 11.71 | 3.15 | 1.59 | 2.37 | 55.77 | 38.82 | 48.14 | 30.86 | 26.79 | 29.64 | 8.14 | 1:7.40 |
| Italian rye grass (*Lolium Italicum* A Br.), | 4 | 92.62 | 90.70 | 91.54 | 9.75 | 6.20 | 8.15 | 2.07 | 1.39 | 1.85 | 52.80 | 43.09 | 49.14 | 36.90 | 31.27 | 33.34 | 7.52 | 1:10.90 |
| Hungarian grass, | 1 | - | - | 92.55 | - | - | 9.45 | - | - | 2.22 | - | - | 50.64 | - | - | 31.96 | 5.73 | 1:6.22 |
| Barn-yard grass (*Panicum crus-galli* L.), | 1 | - | - | 93.35 | - | - | 15.27 | - | - | 1.95 | - | - | 30.24 | - | - | 33.72 | 10.02 | 1:2.94 |
| Low meadow hay, | 1 | - | - | 91.99 | - | - | 9.51 | - | - | 1.88 | - | - | 46.27 | - | - | 35.59 | 6.75 | - |
| Millet, | 5 | 93.85 | 91.90 | 93.00 | 8.11 | 7.09 | 7.59 | 2.67 | .89 | 1.74 | 55.80 | 49.62 | 51.64 | 35.91 | 29.80 | 33.54 | 5.49 | 1:7.78 |
| Oats in blossom, | 1 | - | - | 93.57 | - | - | 6.58 | - | - | 2.92 | - | - | 50.03 | - | - | 34.06 | 6.41 | 1:14.23 |
| Oats in milk, | 1 | - | - | 90.45 | - | - | 10.89 | - | - | 2.69 | - | - | 46.02 | - | - | 34.32 | 6.08 | 1:7.90 |
| Oats, ripe, | 1 | - | - | 91.30 | - | - | 6.05 | - | - | 2.61 | - | - | 48.92 | - | - | 36.31 | 6.11 | 1:15.03 |
| Winter rye in blossom, | 1 | - | - | 91.45 | - | - | 10.66 | - | - | 2.57 | - | - | 47.40 | - | - | 32.97 | 6.40 | 1:8.28 |

## A. *Analyses of Fodder Articles* — Continued.

| NAME. | Analyses. | Dry Matter. | | | One Hundred Parts of Dry Matter contain — Protein. | | | Fat. | | | Nitrogen — Free Extract. | | | Fibre. | | | Ash. | Nutritive Ratio (Average). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | | |
| *II. Hay and Coarse Dry Fodders* — Concluded. | | | | | | | | | | | | | | | | | | |
| Barley in milk, | 1 | - | - | **89.75** | - | - | **10.26** | - | - | **2.76** | - | - | **52.91** | - | - | **29.12** | 4.95 | 1:9.59 |
| Japanese buckwheat, | 1 | - | - | **94.29** | - | - | **10.80** | - | - | **2.22** | - | - | **38.60** | - | - | **36.02** | 12.36 | - |
| Dry fodder corn, | 4 | 93.35 | 90.58 | **92.11** | 9.31 | 6.17 | **7.74** | 2.76 | 1.11 | **1.84** | 58.89 | 53.86 | **55.97** | 33.75 | 23.03 | **29.31** | 5.14 | - |
| Corn stover, | 25 | 94.44 | 75.00 | **88.50** | 12.15 | 5.46 | **7.35** | 2.63 | 1.08 | **1.33** | 63.05 | 44.65 | **50.83** | 38.83 | 20.93 | **34.85** | 5.64 | 1:11.49 |
| Teosinte (*Euchlæna luxurians* Dur. and Asch.), | 1 | - | - | **93.94** | - | - | **9.71** | - | - | **1.28** | - | - | **53.18** | - | - | **28.88** | 6.95 | - |
| Mammoth red clover (*Trifolium medium* L.), | 3 | 92.66 | 82.47 | **88.59** | 18.50 | 14.06 | **15.75** | 2.25 | 1.86 | **2.13** | 48.98 | 46.51 | **44.77** | 33.72 | 20.16 | **27.51** | 9.84 | 1:5.10 |
| Medium red clover (*Trifolium pratense* L.), | 2 | 94.90 | 93.98 | **94.44** | 15.01 | 14.63 | **14.82** | 2.62 | 2.36 | **2.49** | 43.88 | 42.81 | **43.34** | 30.76 | 29.97 | **30.37** | 8.98 | 1:5.52 |
| Alsike clover (*Trifolium hybridum* L.), | 6 | 93.92 | 86.48 | **90.07** | 17.55 | 14.77 | **16.63** | 3.26 | 1.88 | **2.58** | 46.64 | 38.03 | **42.72** | 32.34 | 21.44 | **26.17** | 11.90 | 1:3.25 |
| Lucerne (alfalfa) (*Medicago sativa* Desr.), | 5 | 95.40 | 84.00 | **91.40** | 16.34 | 11.12 | **14.22** | 2.50 | 1.04 | **1.65** | 51.62 | 40.25 | **46.20** | 34.39 | 25.42 | **29.72** | 8.11 | 1:4.09 |
| Sand lucerne, in bloom (*Medicago media* Pers.), | 1 | - | - | **91.20** | - | - | **16.26** | - | - | **2.59** | - | - | **50.31** | - | - | **21.27** | 9.57 | 1:3.50 |
| Bokhara clover (*Melilotus alba* Desr.), | 2 | 93.64 | 91.50 | **92.57** | 14.93 | 11.81 | **13.37** | 4.79 | 1.85 | **3.32** | 51.36 | 38.83 | **45.08** | 33.05 | 28.08 | **30.57** | 7.66 | - |
| Blue melilot (*Melilotus cærulea* Desr.), | 1 | - | - | **91.78** | - | - | **13.81** | - | - | **1.67** | - | - | **43.22** | - | - | **27.17** | 14.87 | - |
| Sainfoin (*Onobrychis sativa*), | 1 | - | - | **87.83** | - | - | **17.70** | - | - | **4.49** | - | - | **42.27** | - | - | **26.95** | 8.54 | - |
| Sulla (*Hedysarum coronarium*), | 2 | 91.68 | 89.59 | **90.61** | 17.03 | 16.90 | **16.97** | 3.16 | 2.39 | **2.78** | 58.66 | 41.89 | **50.26** | 28.95 | 12.38 | **20.67** | 9.32 | - |
| Hairy lotus (*Lotus villosus* Thuill.), | 2 | 89.32 | 87.64 | **88.48** | 16.12 | 13.49 | **14.81** | 3.00 | 2.69 | **2.85** | 57.82 | 50.80 | **54.29** | 24.48 | 15.07 | **19.78** | 8.27 | - |
| Soja bean, | 3 | 93.88 | 79.91 | **89.10** | 19.06 | 15.10 | **16.68** | 8.33 | 5.62 | **6.77** | 51.28 | 41.09 | **46.96** | 25.84 | 20.76 | **22.79** | 6.90 | 1:4.23 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cow-pea, | 3 | 90.70 | 90.25 | 90.43 | 17.17 | 16.95 | 17.05 | 4.49 | 3.81 | 4.06 | 51.41 | 46.06 | 47.93 | 23.58 | 19.06 | 21.67 | 9.29 | 1:4.82 |
| Small pea (*Lathyrus sativus*), | 1 | - | - | 94.20 | - | - | 16.57 | - | - | 1.49 | - | - | 42.76 | - | - | 32.88 | 6.30 | - |
| Serradella, | 3 | 92.80 | 87.23 | 90.44 | 17.97 | 15.26 | 17.03 | 2.91 | 2.37 | 2.55 | 50.23 | 44.49 | 48.18 | 25.92 | 24.37 | 25.15 | 7.09 | 1:4.85 |
| Hairy vetch (*Vicia villosa* Roth.), | 1 | - | - | 92.56 | - | - | 19.58 | - | - | 1.22 | - | - | 38.95 | - | - | 31.88 | 8.37 | - |
| Common vetch (*Vicia sativa* L.), | 2 | 91.65 | 90.55 | 91.10 | 15.76 | 14.42 | 15.09 | 2.69 | 2.30 | 2.50 | 44.34 | 43.29 | 43.80 | 30.68 | 30.05 | 30.37 | 8.24 | 1:3.87 |
| Scotch tares, | 1 | - | - | 84.20 | - | - | 22.00 | - | - | 1.89 | - | - | 31.46 | - | - | 30.89 | 13.76 | - |
| Vetch and oats, | 2 | 94.22 | 87.47 | 90.85 | 7.72 | 7.70 | 7.71 | 3.37 | 2.53 | 2.95 | 49.95 | 49.00 | 49.47 | 36.22 | 31.73 | 33.98 | 5.89 | 1:11.49 |
| Horse-bean straw, | 1 | - | - | 90.85 | - | - | 9.69 | - | - | 1.51 | - | - | 37.77 | - | - | 41.44 | 9.59 | 1:8.55 |
| Soja-bean straw, | 1 | - | - | 87.00 | - | - | 5.39 | - | - | 1.80 | - | - | 43.72 | - | - | 43.85 | 5.24 | - |
| White daisy (*Chrysanthemum Leucanthemum* L.), | 1 | - | - | 90.35 | - | - | 7.68 | - | - | 2.32 | - | - | 46.86 | - | - | 36.09 | 7.05 | - |
| Dry carrot tops, | 1 | - | - | 90.24 | - | - | 20.12 | - | - | 2.01 | - | - | 50.39 | - | - | 13.61 | 13.87 | - |
| Wheat straw, | 1 | - | - | 93.80 | - | - | 7.20 | - | - | 1.63 | - | - | 50.46 | - | - | 35.91 | 4.80 | 1:8.00 |
| Barley straw, | 1 | - | - | 88.56 | - | - | 9.24 | - | - | 3.38 | - | - | 48.23 | - | - | 33.85 | 5.30 | - |
| *III. Roots, Bulbs, Tubers, etc.* | | | | | | | | | | | | | | | | | | |
| Beets, red, | 7 | 14.51 | 9.75 | 12.17 | 15.40 | 7.82 | 12.29 | 1.76 | .59 | .94 | 79.33 | 66.87 | 72.19 | 7.56 | 4.29 | 6.00 | 8.58 | 1:8.24 |
| Beets, sugar, | 11 | 19.53 | 9.87 | 14.73 | 17.44 | 7.32 | 10.97 | .83 | .58 | .66 | 81.50 | 61.93 | 75.93 | 9.69 | 4.82 | 6.49 | 5.95 | 1:11.80 |
| Beets, yellow fodder, | 1 | - | - | 9.40 | - | - | 12.78 | - | - | 1.80 | - | - | 67.50 | - | - | 7.83 | 10.09 | 1:8.33 |
| Mangolds, | 3 | 13.08 | 11.73 | 12.25 | 12.84 | 7.83 | 10.37 | 1.01 | .73 | .88 | 73.38 | 70.32 | 71.75 | 9.54 | 7.08 | 7.94 | 9.06 | 1:9.94 |
| Ruta-bagas, | 3 | 12.77 | 8.25 | 10.88 | 11.46 | 10.34 | 11.01 | 2.32 | 1.23 | 1.53 | 68.58 | 62.27 | 65.88 | 13.12 | 11.03 | 11.83 | 9.75 | 1:11.83 |
| Turnips, | 3 | 12.80 | 8.22 | 9.79 | 10.81 | 9.67 | 10.12 | 2.05 | 1.42 | 1.74 | 70.62 | 65.91 | 68.44 | 12.61 | 10.12 | 11.23 | 8.47 | 1:13.26 |
| Carrots, | 4 | 12.52 | 9.95 | 10.72 | 9.63 | 7.98 | 8.93 | 3.94 | 1.67 | 2.34 | 73.96 | 67.24 | 71.27 | 10.76 | 7.55 | 9.19 | 8.27 | 1:9.67 |

## A. *Analyses of Fodder Articles* — Concluded.

| NAME. | Analyses. | Dry Matter. | | | One Hundred Parts of Dry Matter contain — Protein. | | | Fat. | | | Nitrogen — Free Extract. | | | Fibre. | | | Ash. | Nutritive Ratio (Average). |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | Max. | Min. | Aver. | | |
| *III. Roots, Bulbs, Tubers, etc.* — Concluded. | | | | | | | | | | | | | | | | | | |
| Parsnips, | 1 | - | - | 19.66 | - | - | 6.88 | - | - | 3.37 | - | - | 74.65 | - | - | 7.67 | 7.43 | - |
| Potatoes, | 10 | 21.95 | 13.91 | 18.78 | 13.56 | 6.24 | 10.01 | .83 | .17 | .48 | 87.56 | 78.80 | 81.50 | 3.55 | 1.91 | 2.75 | 5.26 | 1:12.25 |
| Apples, | 2 | 24.83 | 19.68 | 22.26 | 4.57 | 3.92 | 4.25 | 2.81 | 1.71 | 2.26 | 86.21 | 83.44 | 84.81 | 7.05 | 6.14 | 6.60 | 2.08 | 1:26.44 |
| *IV. Grains and Other Seeds.* | | | | | | | | | | | | | | | | | | |
| Corn kernels, | 28 | 91.98 | 65.50 | 89.55 | 15.02 | 8.19 | 12.24 | 9.43 | 4.25 | 5.47 | 83.98 | 71.06 | 78.44 | 3.38 | 1.03 | 2.14 | 1.71 | 1:8.16 |
| Corn kernels and cobs (corn and cob meal), | 36 | 94.00 | 83.91 | 89.71 | 15.06 | 7.82 | 10.00 | 5.27 | 3.36 | 4.09 | 81.41 | 70.13 | 76.73 | 10.41 | 5.63 | 7.56 | 1.62 | - |
| Wheat grain, | 1 | - | - | 89.42 | - | - | 15.35 | - | - | 1.79 | - | - | 80.26 | - | - | 2.42 | 2.18 | 1:6.42 |
| Broom-corn seed, | 1 | - | - | 85.90 | - | - | 11.21 | - | - | 4.05 | - | - | 74.05 | - | - | 8.34 | 2.35 | - |
| Soja beans, | 3 | 94.15 | 80.73 | 85.83 | 35.98 | 32.58 | 33.97 | 21.89 | 18.42 | 20.19 | 34.88 | 32.87 | 33.98 | 7.57 | 5.15 | 6.02 | 5.84 | 1:2.61 |
| Horse beans, | 1 | - | - | 89.72 | - | - | 30.03 | - | - | 1.11 | - | - | 56.48 | - | - | 8.11 | 4.27 | 1:2.24 |
| *V. Flour and Meal.* | | | | | | | | | | | | | | | | | | |
| Corn meal, | 25 | 89.95 | 82.96 | 86.03 | 16.08 | 9.73 | 10.87 | 5.08 | 3.10 | 4.48 | 83.24 | 73.20 | 80.80 | 3.60 | 1.20 | 2.18 | 1.67 | 1:9.75 |
| Hominy meal, | 3 | 91.89 | 89.30 | 90.75 | 11.88 | 11.20 | 11.61 | 12.22 | 4.89 | 9.33 | 78.07 | 68.00 | 72.55 | 4.78 | 3.69 | 4.08 | 2.43 | 1:8.82 |
| Ground barley, | 2 | 87.81 | 86.39 | 87.10 | 11.17 | 10.42 | 10.80 | 2.19 | 1.69 | 1.94 | 78.25 | 77.45 | 77.79 | 7.37 | 6.85 | 7.11 | 2.36 | 1:9.72 |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Broom-corn meal, | 1 | - | - | 86.46 | - | - | 11.14 | - | - | 4.13 | - | - | 74.30 | - | - | 8.00 | 2.43 | - |
| Pea meal, | 1 | - | - | 91.15 | - | - | 20.95 | - | - | 1.67 | - | - | 55.02 | - | - | 19.42 | 2.94 | - |
| *VI. By-products and Refuse.* | | | | | | | | | | | | | | | | | | |
| Linseed cake, old process, | 7 | 92.52 | 88.50 | 90.54 | 39.97 | 30.98 | 36.64 | 9.87 | 6.21 | 7.16 | 44.72 | 37.76 | 40.61 | 9.69 | 8.04 | 8.68 | 6.91 | 1:1.66 |
| Linseed cake, new process, | 5 | 94.94 | 88.17 | 92.05 | 41.02 | 35.03 | 39.18 | 4.08 | 2.17 | 3.12 | 46.49 | 40.83 | 41.87 | 10.31 | 8.93 | 9.38 | 6.45 | 1:1.32 |
| Cotton-seed meal, | 9 | 93.16 | 88.81 | 91.31 | 47.04 | 36.54 | 43.12 | 14.72 | 9.57 | 12.89 | 33.87 | 24.64 | 27.50 | 10.83 | 6.28 | 8.29 | 8.20 | 1:1.39 |
| Wheat bran, | 27 | 92.58 | 86.30 | 89.43 | 20.54 | 15.67 | 17.85 | 6.08 | 2.80 | 5.03 | 62.18 | 54.27 | 59.48 | 14.26 | 7.49 | 10.70 | 6.94 | 1:4.12 |
| Wheat middlings, | 6 | 90.75 | 87.57 | 89.93 | 19.21 | 15.13 | 16.72 | 6.46 | 3.19 | 5.31 | 74.30 | 58.03 | 61.77 | 11.21 | 1.40 | 9.21 | 6.99 | 1:4.21 |
| Rye bran, | 2 | 91.82 | 86.30 | 89.06 | 18.98 | 16.52 | 17.75 | 3.03 | 2.07 | 2.55 | 73.56 | 69.24 | 71.70 | 4.54 | 3.46 | 4.00 | 4.30 | 1:4.88 |
| Rye middlings, | 1 | - | - | 87.46 | - | - | 13.15 | - | - | 5.61 | - | - | 73.52 | - | - | 3.70 | 4.02 | 1:7.28 |
| Buckwheat middlings, | 1 | - | - | 88.49 | - | - | 25.49 | - | - | 7.53 | - | - | 66.36 | - | - | 5.18 | 5.44 | - |
| Gluten meal, | 19 | 93.50 | 68.32 | 90.48 | 39.28 | 28.24 | 32.17 | 12.05 | 3.92 | 7.08 | 66.26 | 48.26 | 59.07 | 4.74 | .41 | 1.07 | .61 | 1:2.57 |
| Refuse from starch works, | 1 | - | - | 42.96 | - | - | 22.41 | - | - | 10.17 | - | - | 58.98 | - | - | 7.54 | .90 | - |
| Spent brewer's grain, | 1 | - | - | 93.02 | - | - | 20.49 | - | - | 1.95 | - | - | 55.51 | - | - | 15.90 | 6.15 | 1:3.06 |
| Cocoa dust, from cocoa manufactory, | 1 | - | - | 92.90 | - | - | 15.47 | - | - | 25.85 | - | - | 45.99 | - | - | 5.86 | 6.83 | - |
| Broom-corn waste, | 1 | - | - | 91.30 | - | - | 6.78 | - | - | 1.00 | - | - | 48.09 | - | - | 39.25 | 4.88 | - |
| Cotton hulls, | 2 | 89.83 | 88.55 | 89.10 | 5.36 | 4.90 | 5.13 | 4.27 | 2.36 | 3.31 | 46.75 | 38.59 | 42.67 | 51.40 | 40.24 | 45.82 | 3.07 | - |
| Apple pomace, | 2 | 21.78 | 17.22 | 19.50 | 7.73 | 6.94 | 7.34 | 4.37 | 3.17 | 3.78 | 72.93 | 70.20 | 72.56 | 16.58 | 13.15 | 14.86 | 1.46 | - |
| Apple pomace ensilage, | 1 | - | - | 14.67 | - | - | 8.22 | - | - | 7.36 | - | - | 58.03 | - | - | 22.18 | 4.21 | - |
| Sugar beet pulp, from diffusion battery, | 1 | - | - | 10.32 | - | - | 12.41 | - | - | .95 | - | - | 61.86 | - | - | 23.74 | 1.04 | - |
| Corn cobs, | 4 | - | - | 90.00 | 4.15 | 3.00 | 3.57 | .67 | .38 | .57 | 63.62 | 60.58 | 61.78 | 33.77 | 31.36 | 32.93 | 1.21 | 1:30.85 |
| Palmetto root, | 1 | - | - | 88.49 | - | - | 3.82 | - | - | .53 | - | - | 69.95 | - | - | 21.26 | 4.44 | - |

## B. *Analyses of Fodder Articles with Reference to Fertilizing Ingredients.*

| NAME. | Analyses. | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | Valuation per Ton of 2,000 Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *I. Green Fodders.* | | | | | | | | | | | | |
| Fodder corn, | 14 | 78.61 | .407 | 4.84 | .327 | .048 | .153 | .091 | .018 | .148 | .380 | $2 84 |
| Fodder corn ensilage, | 1 | 71.60 | .360 | - | .330 | .050 | .100 | .090 | .020 | .140 | .040 | 1 68 |
| Sorghum, | 7 | 82.19 | .233 | - | .229 | .025 | .076 | .075 | .012 | .088 | .136 | 1 09 |
| White kibi, | 2 | 76.45 | .489 | 1.22 | .200 | .045 | .232 | .148 | .019 | .136 | .652 | 2 09 |
| Mochi millet, | 3 | 62.58 | .609 | 2.62 | .407 | .120 | .201 | .217 | .021 | .188 | .708 | 2 65 |
| Mix, | 3 | 75.59 | .499 | 1.54 | .363 | .060 | .249 | .245 | .021 | .237 | .527 | 2 38 |
| Green oats, | 3 | 83.36 | .489 | 1.31 | .381 | .217 | .154 | .134 | .018 | .130 | .496 | 2 14 |
| Vetch and oats, | 1 | 86.11 | .236 | 1.72 | .789 | .031 | .087 | .030 | .012 | .094 | .331 | 1 58 |
| Horse bean, | 1 | 74.71 | .675 | 1.45 | 1.370 | .090 | 1.370 | .620 | .200 | .330 | 2.040 | 3 87 |
| Cow-pea vines, | 1 | 78.81 | .274 | 1.47 | .306 | .063 | .300 | .099 | .016 | .098 | .077 | 1 51 |
| Serradella, | 2 | 82.59 | .411 | 1.82 | .420 | .097 | .460 | .067 | .021 | .140 | .097 | 1 92 |
| White lupine, | 1 | 85.35 | .440 | .74 | 1.730 | .680 | 3.070 | .730 | .170 | .350 | .900 | 3 39 |
| Spanish moss, | 1 | 60.80 | .279 | 1.04 | .255 | .263 | .089 | .122 | .029 | .030 | .191 | 1 20 |
| *II. Hay and Dry Course Fodders.* | | | | | | | | | | | | |
| English hay, | 4 | 11.45 | 1.440 | 6.34 | 1.575 | .160 | .399 | .240 | .043 | .391 | .997 | 6 71 |
| Rowen, | 2 | 12.48 | 1.746 | 9.57 | 1.966 | .168 | .814 | .250 | .064 | .464 | 1.920 | 8 16 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Timothy hay, | 2 | 7.52 | 1.260 | 4.93 | 1.530 | .220 | .710 | .100 | - | .460 | 1.170 | 6 14 |
| Red-top, | 4 | 7.71 | 1.150 | 4.59 | 1.020 | .438 | .571 | .134 | .036 | .360 | 1.736 | 5 20 |
| Kentucky blue-grass, | 2 | 5.34 | 1.320 | - | 1.694 | .129 | .398 | - | .044 | .431 | 2.863 | 6 45 |
| Orchard grass, | 4 | 8.84 | 1.310 | 6.42 | 1.879 | .225 | .456 | .297 | .033 | .414 | 2.060 | 6 55 |
| Meadow fescue, | 6 | 8.89 | .992 | 8.08 | 2.096 | .301 | .576 | .187 | .028 | .399 | 1.537 | 5 63 |
| Perennial rye grass, | 2 | 9.13 | 1.227 | 6.79 | 1.553 | .307 | .642 | .337 | .044 | .559 | 2.262 | 6 16 |
| Italian rye grass, | 4 | 8.71 | 1.189 | - | 1.273 | .451 | .857 | .321 | .071 | .556 | 2.598 | 5 79 |
| Salt hay, | 1 | 5.36 | 1.180 | - | .718 | .017 | .371 | .335 | .028 | .248 | - | 4 92 |
| Japanese millet ("white head"), | 1 | 12.07 | 1.365 | - | .788 | - | .323 | .328 | .013 | .418 | 1.228 | 5 81 |
| Japanese buckwheat, | 1 | 5.72 | 1.629 | - | 3.320 | .349 | 3.418 | .421 | .148 | .852 | .378 | 9 38 |
| Fodder corn, | 7 | 7.85 | 1.763 | 4.91 | .889 | .175 | .605 | .500 | .075 | .542 | 1.270 | 7 40 |
| Corn stover, | 16 | 9.12 | 1.043 | 3.74 | 1.400 | .112 | .622 | .384 | .068 | .293 | 1.885 | 5 28 |
| Teosinte, | 1 | 6.06 | 1.460 | 6.53 | 3.696 | .109 | 1.597 | .458 | .021 | .546 | .315 | 8 72 |
| Mammoth red clover, | 3 | 11.41 | 2.231 | 8.72 | 1.223 | .389 | 3.141 | .613 | .111 | .546 | .779 | 9 38 |
| Medium red clover, | 2 | 7.91 | 2.184 | 8.36 | 2.286 | .210 | 1.689 | .402 | .096 | .447 | .919 | 9 91 |
| Alsike clover, | 6 | 9.94 | 2.342 | 11.11 | 2.227 | .309 | 2.153 | .537 | .197 | .668 | 1.776 | 10 65 |
| Lucerne (alfalfa), | 4 | 6.26 | 2.075 | 6.82 | 1.461 | .814 | 2.211 | .406 | .078 | .526 | .513 | 8 92 |
| Bokhara clover, | 2 | 7.43 | 1.975 | 7.70 | 1.832 | .114 | 1.784 | .347 | .023 | .558 | .057 | 8 95 |
| Blue melilot, | 1 | 8.22 | 1.919 | 13.65 | 2.796 | .270 | 1.449 | .260 | .349 | .544 | 4.008 | 9 55 |
| Sainfoin, | 1 | 12.17 | 2.630 | 7.55 | 2.020 | .540 | 1.160 | .430 | .040 | .760 | .470 | 11 57 |
| Sulla, | 2 | 9.39 | 2.460 | - | 2.093 | .223 | 2.497 | .350 | .114 | .453 | .614 | 10 68 |
| Lotus villosus, | 2 | 11.52 | 2.095 | 8.23 | 1.807 | .499 | 2.220 | .476 | .112 | .594 | .976 | 9 37 |

## *B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Continued.

| NAME. | Analyses. | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | Valuation per Ton of 2,000 Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *II. Hay and Dry Coarse Fodders* — Concluded. | | | | | | | | | | | | |
| Soja bean, | 2 | 6.30 | 2.320 | 6.47 | 1.079 | .148 | 2.760 | 1.178 | .115 | .667 | .977 | $9 54 |
| Cow-pea, | 1 | 9.00 | 1.635 | 8.40 | .913 | .122 | 2.696 | .688 | .046 | .527 | .832 | 6 96 |
| Small pea, | 1 | 5.80 | 2.497 | - | 1.990 | .469 | 1.373 | .276 | .138 | .592 | 1.081 | 10 89 |
| Serradella, | 2 | 7.39 | 2.697 | 10.60 | .652 | .656 | 2.545 | .461 | .066 | .777 | .590 | 10 64 |
| Scotch tares, | 1 | 15.80 | 2.964 | - | 3.004 | .238 | 1.698 | .354 | .460 | .815 | 4.062 | 13 61 |
| Vetch and oats, | 3 | 9.91 | 1.299 | 9.58 | 1.349 | .420 | .663 | .265 | .098 | .560 | .521 | 6 24 |
| Soja bean straw, | 1 | 13.00 | .750 | - | 1.322 | - | .436 | .469 | .035 | .397 | .218 | 4 15 |
| White daisy, | 1 | 9.65 | .279 | 6.37 | 1.253 | .164 | 1.302 | .191 | .032 | .435 | 1.110 | 2 54 |
| Dry carrot tops, | 1 | 9.76 | 3.130 | 12.52 | 4.883 | 4.028 | 2.089 | .667 | .118 | .612 | .098 | 15 52 |
| Barley straw, | 1 | 11.44 | 1.310 | 5.30 | 2.086 | .183 | .572 | .180 | - | .303 | 2.380 | 6 58 |
| *III. Roots, Bulbs, Tubers, etc.* | | | | | | | | | | | | |
| Beets, red, | 7 | 87.73 | .243 | 1.13 | .436 | .091 | .049 | .033 | .004 | .091 | .020 | 1 31 |
| Beets, sugar, | 4 | 86.95 | .223 | 1.04 | .477 | .081 | .057 | .040 | .013 | .101 | .048 | 1 28 |
| Beets, yellow fodder, | 1 | 90.60 | .192 | .95 | .462 | .104 | .045 | .030 | .005 | .086 | .015 | 1 14 |
| Mangolds, | 2 | 87.29 | .188 | 1.22 | .383 | .125 | .061 | .039 | .005 | .093 | .023 | 1 06 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ruta-bagas, | 3 | 89.13 | .190 | 1.06 | .489 | .070 | .088 | .030 | .004 | .123 | .012 | 1 21 |
| Turnips, | 2 | 89.49 | .178 | 1.01 | .385 | .078 | .089 | .027 | .009 | .104 | .055 | 1 06 |
| Carrots, | 2 | 89.79 | .147 | 9.22 | .506 | .062 | .067 | .023 | .009 | .093 | .019 | 1 04 |
| Parsnips, | 1 | 80.34 | .217 | – | .617 | .006 | .088 | .045 | .005 | .187 | .019 | 1 48 |
| Potatoes, | 1 | 79.75 | .207 | .99 | .294 | .013 | .007 | .020 | .002 | .066 | .006 | 1 03 |
| Apples, | 2 | 79.91 | .130 | .41 | .190 | .030 | .030 | .030 | .003 | .010 | .003 | 49 |
| *IV. Grains and Other Seeds.* | | | | | | | | | | | | |
| Corn kernels, | 13 | 10.88 | 1.822 | 1.53 | .404 | .034 | .032 | .206 | .019 | .699 | .020 | 6 37 |
| Corn kernels and cobs (corn and cob meal), | 29 | 8.96 | 1.409 | – | .472 | .059 | .018 | .176 | .011 | .571 | .430 | 5 88 |
| Soja beans, | 2 | 18.33 | 5.303 | 4.99 | 1.991 | .275 | .419 | .909 | .216 | 1.869 | .093 | 21 96 |
| *V. Flour and Meal.* | | | | | | | | | | | | |
| Corn meal, | 2 | 13.52 | 2.050 | 1.42 | .435 | .064 | .034 | .187 | .015 | .707 | .005 | 7 85 |
| Hominy feed, | 1 | 8.93 | 1.630 | 2.21 | .490 | – | .180 | .280 | – | .980 | – | 6 14 |
| Ground barley, | 1 | 13.43 | 1.550 | 2.06 | .341 | .169 | .091 | .173 | .013 | .660 | .669 | 6 25 |
| Wheat flour, | 1 | 9.83 | 2.210 | 1.22 | .540 | – | .170 | .050 | – | .570 | – | 8 65 |
| Pea meal, | 1 | 8.85 | 3.080 | 2.68 | .993 | .618 | .302 | .302 | .027 | .820 | .122 | 11 31 |
| *VI. By-products and Refuse.* | | | | | | | | | | | | |
| Linseed cake, old process, | 4 | 8.02 | 5.390 | 6.57 | 1.214 | .860 | .664 | .763 | .060 | 1.780 | .340 | 21 49 |
| Linseed cake, new process, | 4 | 7.35 | 5.808 | 5.04 | 1.288 | .823 | .663 | .655 | .062 | 1.628 | .345 | 22 80 |
| Cotton-seed meal, | 9 | 8.96 | 6.467 | 6.49 | 1.723 | .291 | .587 | .589 | .020 | 2.333 | .457 | 26 25 |

*B. Analyses of Fodder Articles with Reference to Fertilizing Ingredients* — Concluded.

| NAME. | Analyses. | Moisture. | Nitrogen. | Ash. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | Valuation per Ton of 2,000 Pounds. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *VI. By-products and Refuse* — Concluded. | | | | | | | | | | | | |
| Wheat bran, | 5 | 11.39 | 2.879 | 6.44 | 1.625 | .159 | .168 | .899 | .019 | 2.845 | .141 | $14 58 |
| Wheat middlings, | 1 | 9.18 | 2.630 | 2.30 | .630 | .110 | .200 | .210 | - | .950 | - | 10 63 |
| Rye middlings, | 1 | 12.54 | 1.840 | 3.52 | .810 | .030 | .090 | .320 | .020 | 1.260 | .170 | 8 46 |
| Gluten meal, | 4 | 8.53 | 5.430 | .65 | .045 | .018 | .050 | .035 | .069 | .425 | - | 19 01 |
| Spent brewer's grain, | 1 | 6.98 | 3.050 | 6.15 | 1.550 | .347 | .296 | .286 | .159 | 1.260 | 1.770 | 12 14 |
| Cocoa dust, | 1 | 7.10 | 2.299 | 6.35 | .630 | - | .630 | - | - | 1.340 | - | 11 22 |
| Broom-corn waste (stalks), | 1 | 10.37 | .870 | 4.70 | 1.858 | - | .242 | .170 | - | .460 | 1.000 | 5 09 |
| Cotton hulls, | 3 | 10.63 | .750 | 2.61 | 1.080 | - | .200 | .260 | - | .180 | .060 | 3 74 |
| Apple pomace, | 2 | 80.50 | .227 | .271 | .134 | .026 | .037 | .028 | .008 | .018 | .009 | 90 |
| Corn cobs, | 8 | 12.09 | .504 | .815 | .598 | .071 | .025 | .045 | .009 | .063 | .190 | 2 44 |
| Palmetto root, | 1 | 11.51 | .540 | .393 | 1.380 | .345 | .045 | .004 | .017 | .157 | .410 | 3 20 |

## C. *Analyses of Fruits.*

| NAME. | Date. | Dry Matter. | Specific Gravity of Juice. | Temperature C. of Juice (Degrees). | Total Sugar in Juice. | Glucose in Juice. | Cane Sugar in Juice. | *Soda Sol. required to neutralize 100 parts Juice. |
|---|---|---|---|---|---|---|---|---|
| | 1877. | Per ct. | | | Per ct. | Per ct. | Per ct. | C. C. |
| Apple (Baldwin), . . . . | Sept. 1, | 20.14 | 1.055 | 12—15 | 3.09 | - | - | - |
| Apple (Baldwin), . . . . | Oct. 9, | 19.66 | 1.065 | 12—15 | 6.25 | - | - | - |
| Apple (Baldwin), . . . . | Nov. 27, | - | 1.075 | 12—15 | 10.42 | - | - | - |
| Rhode Island Greening, . . | Sept. 1, | 20.27 | 1.055 | 12—15 | 3.16 | - | - | - |
| Rhode Island Greening, . . | Oct. 9, | 19.68 | 1.066 | 12—15 | 7.14 | - | - | - |
| Rhode Island Greening,† . . | Nov. 27, | 20.25 | 1.080 | 12—15 | 11.36 | - | - | - |
| Pear (Bartlett), . . . . . | Aug. 31, | 15.00 | 1.060 | 12—15 | 4.77 | - | - | - |
| Pear (Bartlett), . . . . . | Sept. 7, | 16.55 | 1.060 | 12—15 | 5.68 | - | - | - |
| Pear (Bartlett), . . . . . | Sept. 20, | - | 1.065 | 12—15 | 8.62 | - | - | - |
| Pear (Bartlett),‡ . . . . | Sept. 22, | - | 1.060 | 12—15 | 8.93 | - | - | - |
| Cranberries, . . . . . | - | 10.71 | 1.025 | 15 | 1.35 | - | - | -§ |
| Cranberries, . . . . . | 1878. | 10.11 | 1.025 | 15 | 1.70 | - | - | -‖ |
| Early York Peach (ripe), . | - | - | 1.045 | 25 | - | 1.92 | 6.09 | 45 |
| Early York Peach (nearly ripe), | - | 10.96¶ | 1.039 | 25 | - | 1.36 | 4.12 | 42.3 |
| Crawford Peach (nearly ripe), | - | - | 1.050 | 18 | - | 2.19 | 7.02 | 85.6 |
| Crawford Peach (mellow), . | - | 11.36¶ | 1.055 | 18 | - | 1.70 | 8.94 | 76 |
| Crawford Peach (not mellow), | - | 11.88¶ | 1.045 | 22 | - | 1.67 | 5.92 | 64 |

* One part $Na_2CO_3$ in 100 parts of water.
† Picked October 9.
‡ Picked September 7.
§ Free acid, 2.25 per cent.
‖ Free acid, 2.43 per cent.
¶ In pulp, kept ten days before testing.

## C. *Analyses of Fruits* — Continued.

[Wild and cultivated grapes.]

| NAME. | Date. | Specific Gravity. | Temperature C. (Degrees). | Dry Matter. | Glucose in Juice. | Sugar in Dry Matter. | *Soda Sol. required to neutralize 100 parts Juice. |
|---|---|---|---|---|---|---|---|
| | 1876. | | | Per ct. | Per ct. | Per ct. | C.C. |
| Concord, . . . . . . . | July 17, | 1.0175 | 31 | 8.30 | .645 | 7.77 | – |
| Concord, . . . . . . . | July 20, | 1.0150 | 31 | 8.10 | .625 | 7.72 | 216 |
| Concord, . . . . . . . | Aug. 2, | 1.0200 | 25 | 9.94 | .938 | 9.44 | 249 |
| Concord, . . . . . . . | Aug. 16, | 1.0250 | 28 | 10.88 | 2.000 | 18.38 | 229 |
| Concord, . . . . . . . | Aug. 30, | 1.0500 | 25 | 15.58 | 8.620 | 55.33 | 120 |
| Concord, . . . . . . . | Sept. 13, | 1.0670 | 23 | 17.48 | 13.890 | 79.46 | 55 |
| Concord, . . . . . . . | Sept. 4, | 1.0700 | 18 | 19.82 | 16.130 | 81.38 | 49.2 |
| Purple Wild Grape, . . . | July 19, | 1.020 | 31 | 9.00 | .714 | 7.93 | 204 |
| Purple Wild Grape, . . . | Aug. 4, | 1.020 | 28 | 12.25 | 1.100 | 8.98 | 246 |
| Purple Wild Grape, . . . | Aug. 16, | 1.025 | 28 | 12.48 | 2.000 | 16.03 | 233 |
| Purple Wild Grape, . . . | Aug. 30, | 1.050 | 26 | 16.58 | 6.500 | 39.81 | 147.6 |
| White Wild Grape, . . . | Aug. 31, | 1.050 | 26 | 16.48 | 9.260 | 56.18 | 98 |
| Hartford Prolific, . . . . | Sept. 5, | 1.060 | 22 | 17.39 | 13.89 | 79.87 | 88.8 |
| Ives' Seedling, . . . . | Sept. 6, | 1.070 | 26 | 20.15 | 15.15 | 75.14 | 88.6 |
| Iona, . . . . . . . | Sept. 7, | 1.080 | 21 | 24.56 | 15.15 | 61.68 | 144 |
| Iona (mildewed), . . . . | Sept. 7, | 1.045 | 26 | 15.41 | 6.25 | 40.56 | 204.4 |
| Agawam, . . . . . . . | Sept. 11, | 1.075 | 20 | 20.79 | 17.24 | 82.92 | 94.8 |
| Wilder, . . . . . . . | Sept. 11, | 1.064 | 20 | 16.53 | 13.67 | 82.69 | 56 |
| Delaware, . . . . . . | Sept. 12, | 1.080 | 24 | 23.47 | 17.86 | 76.09 | 74 |
| Charter Oak, . . . . . . | Sept. 12, | 1.080 | 24 | 15.98 | 8.77 | 54.94 | 168.3 |
| Israella, . . . . . . . | Sept. 16, | 1.075 | 23 | 19.67 | 9.20 | 46.77 | 89.8 |
| Bent's Seedling, . . . . | Sept. 20, | 1.080 | 21 | 20.65 | 16.13 | 78.11 | 181.8 |
| Adirondack, . . . . . . | Sept. 20, | 1.065 | 21 | 15.11 | 13.17 | 87.16 | 68 |
| Catawba, . . . . . . . | Oct. 16, | 1.080 | 13 | 23.45 | 17.39 | 74.16 | 82 |
| | 1877. | | | | | | |
| Wilder, . . . . . . . | Sept. 11, | 1.065 | 23 | 16.41 | 15.15 | 92.32 | 60 |
| Charter Oak, . . . . . . | Sept. 12, | 1.055 | 23 | 16.22 | 9.80 | 60.42 | 96 |
| Concord, . . . . . . . | Sept. 13, | 1.065 | 24 | 15.90 | 13.16 | 82.76 | 102 |
| Concord, . . . . . . . | Sept. 26, | 1.075 | 24 | 19.34 | 15.43 | 79.78 | 70.8 |
| Eumalan, . . . . . . . | Sept. 24, | 1.065 | 16 | 19.62 | 13.16 | 67.07 | 73 |
| Wild White Grape, . . . | Sept. 5, | 1.050 | 22 | 15.57 | 7.20 | 46.24 | 140.8 |
| Wild White Grape (shrivelled), . | Sept. 20, | 1.060 | 16 | 20.02 | 10.00 | 49.95 | 130 |
| Wild Purple Grape (shrivelled), . | Sept. 20, | 1.045 | 16 | 16.69 | 8.22 | 49.25 | 104 |

* One part of pure $Na_2CO_3$ in 100 parts water.

## *C. Analyses of Fruits* — Continued.

[Effect of girdling on grapes.]

| NAME AND CONDITION. | Date. | Specific Gravity. | Temperature C. (Degrees). | Dry Matter at 100° C. | Glucose in Juice. | Sugar in Dry Matter. | *Soda Sol. required to neutralize 100 parts Juice. |
|---|---|---|---|---|---|---|---|
| | 1877. | | | Per ct. | Per ct. | Per ct. | C. C. |
| Hartford Prolific, not girdled, | Sept. 3, | 1.045 | 19 | 12.85 | 8.77 | 68.25 | 111.4 |
| Hartford Prolific, girdled, | Sept. 3, | 1.065 | 19 | 17.18 | 12.50 | 72.76 | 100 |
| Wilder, not girdled, | Sept. 3, | 1.055 | 19 | 15.41 | 10.42 | 67.62 | 108.2 |
| Wilder, girdled, | Sept. 3, | 1.075 | 19 | 17.24 | 14.70 | 85.26 | 88.4 |
| Delaware, not girdled, | Sept. 4, | 1.065 | 19 | 15.75 | 11.76 | 74.66 | 101.2 |
| Delaware, girdled, | Sept. 4, | 1.075 | 19 | 19.14 | 15.15 | 79.16 | 94.4 |
| Agawam, not girdled, | Sept. 4, | 1.060 | 19 | 16.60 | 11.37 | 68.48 | 128.2 |
| Agawam, girdled, | Sept. 4, | 1.075 | 19 | 18.45 | 16.31 | 87.42 | 114.8 |
| Iona, not girdled, | Sept. 6, | 1.0625 | 22 | 16.60 | 13.51 | 68.31 | 131.4 |
| Iona, girdled, | Sept. 6, | 1.085 | 22 | 21.48 | 15.63 | 72.76 | 125.6 |
| Concord, not girdled, | Sept. 6, | 1.045 | 22 | 13.46 | 7.46 | 55.42 | 182.4 |
| Concord, girdled, | Sept. 6, | 1.070 | 22 | 17.53 | 13.88 | 79.18 | 102.8 |
| Concord, not girdled, | Sept. 26, | 1.065 | 22 | 17.63 | 13.70 | 78.27 | 86 |
| Concord, girdled, | Sept. 26, | 1.080 | 22 | 24.47 | 19.61 | 80.13 | 76.8 |
| Concord, not girdled, | Oct. 5, | 1.075 | 12 | 20.92 | 17.50 | 85.37 | 42 |
| Concord, girdled, | Oct. 5, | 1.085 | 12 | - | 17.86 | - | 54 |

| | Date. | 100 PARTS OF GRAPES CONTAINED — Ash. | Moisture. | Glucose. | Tartaric Acid. |
|---|---|---|---|---|---|
| | 1889. | | | | |
| Concord, not girdled, | Sept. 23, | - | 84.69 | 6.24 | .75 |
| Concord, girdled, | Sept. 23, | .42 | 83.00 | 8.13 | .85 |
| Concord, not girdled, | Oct. 8, | .53 | 84.51 | 6.09 | .48 |
| Concord, girdled, | Oct. 8, | .37 | 82.69 | 8.50 | .50 |
| | 1890. | | | | |
| Concord, not girdled, | Sept. 25, | .47 | 86.49 | 7.36 | 1.15 |
| Concord, girdled, | Sept. 25, | .48 | 84.93 | 9.29 | 1.17 |
| Concord, not girdled, | Oct. 9, | .53 | 85.39 | 7.67 | .71 |
| Concord, not girdled, | Oct. 9, | .59 | 85.11 | 6.65 | .51 |
| Concord, girdled, | Oct. 9, | .54 | 85.15 | 9.12 | .74 |

* One part of pure $Na_2CO_3$ in 100 parts water.

## C. *Analyses of Fruits* — Continued.

[Effect of fertilization upon the organic constituents of wild grapes.]

| NAME. | Date. | Dry Matter. | Specific Gravity. | Temperature C. (Degrees). | Per Cent. of Glucose. | Per Cent. of Acids. | Remarks. |
|---|---|---|---|---|---|---|---|
| | 1877. | | | | | | |
| Wild Purple Grape Berries, . | Sept. 20, | 16.31 | - | - | 8.03 | - | Unfertilized. |
| Wild Purple Grape Berries, . | " | 19.55 | - | - | 13.51 | - | Fertilized. |
| Wild Purple Grape Juice, . . | " | - | 1.045 | 16 | 8.22 | 9.840 | Unfertilized. |
| Wild Purple Grape Juice, . . | " | - | 1.065 | 16 | 13.51 | 1.149 | Fertilized. |
| Wild White Grape Berries, . . | " | 20.02 | - | - | - | - | Unfertilized. |
| Wild White Grape Berries, . . | " | 21.65 | - | - | - | - | Fertilized. |
| Wild White Grape Juice, . . | " | - | 1.060 | 16 | 10.00 | 1.846 | Unfertilized. |
| Wild White Grape Juice, . . | " | - | - | - | 14.29 | .923 | Fertilized. |

[Effect of fertilization upon the ash constituents of grapes.]

| NAME. | Date. | Potassium Oxide. | Sodium Oxide. | Calcium Oxide. | Magnesium Oxide. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| | 1876. | | | | | | | | |
| Wild Purple Grapes, | Sept. 13, | 50.93 | .15 | 22.23 | 5.59 | .79 | 17.40 | 2.93 | Unfertilized. |
| Wild Purple Grapes, | Sept. 20, | 62 65 | .85 | 14.24 | 3.92 | .53 | 13.18 | 4.63 | Fertilized. |
| Concord Grapes, . | July 7, | 41 73 | 5.04 | 25.03 | 7.80 | .55 | 18.48 | 1.37 | Unfertilized. |
| Concord Grapes, . | July 17, | 47.34 | 1.13 | 24.21 | - | .75 | 21.38 | .43 | Unfertilized. |
| Concord Grapes, . | Aug. 18, | 51.14 | 3.19 | 16.20 | 6.38 | .65 | 20.77 | 1.67 | Unfertilized. |
| Concord Grapes, . | Sept. 13, | 57.15 | 4.17 | 11.30 | 3.10 | .40 | 12.47 | 11.82 | Unfertilized. |
| | 1878. | | | | | | | | |
| Concord Grapes, . | Oct. 3, | 64.65 | 1.42 | 9.13 | 3.63 | .50 | 14.87 | 5.80 | Fertilized. |

## *C. Analyses of Fruits* — Concluded.

[Ash analyses of fruits and garden crops.]

| NAME. | Ash. | 100 Parts of Ash contained — Potash. | Soda. | Lime. | Magnesia. | Ferric Oxide. | Phosphoric Acid. | Insoluble Matter. |
|---|---|---|---|---|---|---|---|---|
| Concord Grape (fruit), | - | 51.14 | 3.19 | 16.20 | 6.38 | .65 | 20.77 | 1.67 |
| Unfermented juice, | - | 50.85 | .48 | 3.69 | 4.25 | .10 | 6.43 | .90 |
| Fermented juice, | - | 40.69 | - | 6.85 | 6.24 | - | 9.04 | - |
| Skins and pulp, | - | 7.70 | .42 | 57.36 | 8.80 | .08 | 24.40 | 1.32 |
| Seeds, | 3.08 | 6.71 | - | - | 3.03 | - | 17.20 | .29 |
| Stems of grapes, | 4.69 | 20.91 | - | 20.20 | 8.45 | - | 17.75 | 2.09 |
| Young branches,* | - | 24.71 | .94 | 40.53 | 10.66 | 1.08 | 17.16 | 4.92 |
| Wood of vine,† | 2.97 | 22.57 | - | 9.72 | 4.28 | - | 14.07 | 23.84 |
| Clinton Grape (fruit), | - | 58.45 | 3.51 | 13.34 | 7.37 | .90 | 18.19 | - |
| Baldwin Apple, | - | 63.54 | 1.71 | 7.28 | 5.52 | 1.08 | 20.87 | 3.68 |
| Strawberry (fruit),‡ | .52 | 49.24 | 3.23 | 13.47 | 8.12 | 1.74 | 18.50 | 5.66 |
| Strawberry (fruit),§ | - | 58.47 | - | 14.64 | 6.12 | 3.37 | 17.40 | - |
| Strawberry vines, | 3.34 | 10.62 | 13.35 | 36.63 | 3.83 | 6.91 | 14.48 | 14.17 |
| Cranberry (fruit), | .18 | 47.96 | 6.58 | 18.58 | 6.78 | - | 14.27 | - |
| Cranberry vines, | 2.45 | 12.98 | 3.27 | 16.49 | 10.33 | 3.35 | 10.94 | 34.04 |
| Currants, red, | .47 | 47.68 | 4.02 | 18.96 | 6.23 | 1.20 | 21.91 | - |
| Currants, white, | .59 | 52.79 | 3.00 | 17.08 | 5.68 | 2.67 | 18.78 | - |
| Crawford Peach, sound, | - | 74.46 | - | 2.64 | 6.29 | .58 | 16.02 | - |
| Crawford Peach, diseased,‖ | - | 71.30 | - | 4.68 | 5.49 | .46 | 18.07 | - |
| Branch, sound, | - | 26.01 | - | 54.52 | 7.58 | .52 | 11.37 | - |
| Branch, diseased,‖ | - | 15.67 | - | 64.23 | 10.28 | 1.45 | 8.37 | - |
| Asparagus stems, | - | 42.94 | 3.58 | 27.18 | 12.77 | 1.22 | 12.31 | .08 |
| Asparagus roots, | - | 56.43 | 5.42 | 15.48 | 7.57 | - | 15.09 | 3.67 |
| Onions, | - | 38.51 | 1.90 | 8.20 | 3.65 | .58 | 15.80 | 3.33 |

* With tendrils and blossoms. † One year old. ‡ Wilder. § Downing. ‖ Yellows.

## *D. Analyses of Sugar-producing Plants.*

[Composition of sugar beets raised upon the college grounds during the season of 1870 and 1871.]

| NAME. | Date. | Brix Saccharometer (Degrees). | Per Cent. of Sugar. | Non-saccharine Substances. |
|---|---|---|---|---|
| Electoral, . . . . . . | Sept. 10, | 14 | 12.30 | 1.75 |
| Imperial, . . . . . . | " 12, | 15 | 12.59 | 2.41 |
| Vilmorin, . . . . . . | " 13, | 14.5 | 12.95 | 1.55 |
| Imperial, . . . . | " 18, | 14 | 10.79 | 3.21 |
| Imperial, . . . . . . | Oct. 11, | 15 | 12.05 | 2.95 |
| Electoral, . . . . . . | " 16, | 15 | 12.22 | 2.78 |
| Vilmorin, . . . . . . | " 18, | 16 | 13.13 | 2.87 |
| Imperial, . . . . . . | Nov. 14, | 15 | 11.60 | 3.34 |
| Vilmorin, . . . . . . | " 21, | 15.5 | 13.12 | 2.38 |
| Vienna Globe,* . . . . | Sept. 19, | 11 | 8.00 | 3.00 |
| Common Mangold,* . . . | " 19, | 9 | 5.00 | 3.97 |

* Fodder beets.

[Percentage of sugar in different varieties of sugar beets grown on college farm during the season of 1882.]

| NAME. | Source of Seed. | Weight in Pounds. | Per Cent. of Sugar in Juice. |
|---|---|---|---|
| I. Vilmorin, . . . . . . | Saxony, . | $\frac{3}{4}$ to $\frac{7}{8}$ | 15.50 |
| II. Vilmorin, . . . . . . | Saxony, . | $\frac{3}{4}$ to 1 | 15.61 |
| I. White Imperial, . . . . . | Saxony, . | $\frac{3}{4}$ to $1\frac{3}{4}$ | 14.20 |
| II. White Imperial, . . . . . | Saxony, . | $1\frac{3}{4}$ to 2 | 10.27 |
| New Imperial, . . . . . . | Saxony, . | $1\frac{1}{4}$ to $1\frac{3}{4}$ | 13.80 |
| I. White Magdeburg, . . | Saxony, . | $1\frac{1}{2}$ to 2 | 13.10 |
| II. White Magdeburg, . . . | Silesia, . | $1\frac{1}{2}$ to $1\frac{3}{4}$ | 10.06 |
| Quedlinburg, . . . . . . | Saxony, . | $1\frac{1}{2}$ to $1\frac{3}{4}$ | 13.44 |
| White Silesian, . . . . . . | Silesia, . | $1\frac{1}{4}$ to $1\frac{1}{2}$ | 9.72 |

*D. Analyses of Sugar-producing Plants* — Continued.

[Effect of soil and fertilization on Electoral sugar beets.*]

| SOIL. | MANURE. | Specific Gravity Brix (Degrees). | Per Cent. of Sugar in Juice. | Non-saccharine Substances. | Cane Sugar in Soluble Matter. |
|---|---|---|---|---|---|
| Sandy loam, | Fresh yard-manure, | 16.5 | 12.50 | 4.00 | 75.08 |
| Clayish loam, | Fresh yard-manure, | 15.5 | 11.05 | 4.45 | 71.30 |
| Warm alluvial, | Yard-manure and chemicals, | 12.75 | 9.17 | 3.58 | 71.92 |
| Warm alluvial, | Fresh hog-manure, | 13.5 | 9.53 | 3.97 | 70.06 |
| Light, sandy soil, | No manure, | 18.5 | 13.73 | 4.77 | 74.21 |
| Alluvial soil, | Brighton fish, | 14.5 | 11.15 | 3.35 | 76.90 |
| Heavy soil, | Yard-manure, | 12.25 | 8.15 | 4.10 | 66.53 |
| – | – | 13.5 | 9.90 | 3.60 | 73.33 |

* Not raised on college farm (Connecticut valley).

[Effect of fertilization on sugar beets.*]

| FERTILIZERS. | PERCENTAGES OF SUGAR IN JUICE. | | |
|---|---|---|---|
| | Freeport. | Electoral. | Vilmorin. |
| Fresh horse-manure, | 11.96 | 9.42 | 7.80 |
| Blood guano without potash, | 10.99 | 10.10 | 10.20 |
| Blood guano with potash, | 12.55 | 13.24 | 10.50 |
| Kainite and superphosphate, | 13.15 | 12.16 | 10.50 |
| Sulphate of potash, | 14.52 | 14.32 | 12.78 |
| Second year after stable-manure, | 13.49 | 12.78 | 12.19 |

* All were grown on the same soil, — sandy loam (college)

### *D. Analyses of Sugar-producing Plants* — Continued.

[Effect of different modes of cultivation on Electoral sugar beets.]

| Locality of Beet-field. | Date. | Brix Saccharom-eter (Degrees). | Per Cent. of Cane Sugar. | Non-saccharine Substances. |
|---|---|---|---|---|
| 1. Sing Sing, N. Y., | 1872–73 | 11 | 7.80 | 3.20 |
| 2. Washington, N. Y., | " | 14 | 10.97 | 3.03 |
| 3. South Hartford, N. Y., | " | 15 | 11.70 | 3.30 |
| 4. Greenwich, N. Y., | " | 12 | 9.50 | 2.50 |
| 5. Frankfort, N. Y., | " | 13.5 | 11.00 | 2.50 |
| 6. Albion, N. Y.,* | " | 18 | 15.10 | 2.90 |
| Albion, N. Y.,† | " | 14 | 9.70 | 4.30 |

* From beets weighing from 1½ to 2 pounds. † From beets weighing from 10 to 14 pounds.

1. Soil, loam resting on clayish hard-pan, had been for several years in grass. Tomatoes had been the preceding crop. Five hundred pounds of a phosphatic blood guano were applied before planting.

2. Soil, a clayish loam, had been ploughed seven inches deep. A liberal amount of rotten sheep-manure was placed in trenches and covered by running two furrows together, thus forming a ridge on which the seed were planted.

3. Soil, a gravelly loam, which had been richly manured with stable compost and twice ploughed before planting.

4. Soil, a sandy loam, underlaid by fine sand. The seed were planted on ridges, which covered trenches containing a little rotten stable-manure.

5. No details of modes of cultivation received.

6. Soil, a dark, reddish-brown, rich, deep, sandy loam. Clover had been raised for two years previous to a crop of carrots, which preceded the sugar beets. The beets were the second crop after the application of twenty loads of stable-manure per acre.

### *Composition of Canada-grown Sugar Beets.*

[1872 and 1873.]

| Where Grown. | Weight of Roots. | Specific Gravity of Juice (Brix). | Tempera-ture of Juice. | Per Cent. of Cane Sugar in Juice. |
|---|---|---|---|---|
| Echaullon de Montreal, | 2 to $2\frac{1}{2}$ lbs. | 15.4° | 64° F. | 11.38 |
| Riviere du Loup, | 2 to $3\frac{1}{4}$ lbs. | 14.5° | 63° F. | 10.20 |
| Chambly, | 2 to $2\frac{1}{2}$ lbs. | 13.2° | 63° F. | 9.02 |
| Maskinonge, | 2 to 3 lbs. | 13.4° | 63° F. | 8.83 |

## *D. Analyses of Sugar-producing Plants* — Continued.

[Early Amber Cane.]

| Date. | Condition of Cane. | Brix Saccharometer (Degrees). | Temperature C. (Degrees). | Glucose. | Cane Sugar. | Soda Solution required to neutralize 100 parts of Juice. | Solids. |
|---|---|---|---|---|---|---|---|
| | | | | Per ct. | Per ct. | C. C. | Per ct. |
| **1879.** | | | | | | | |
| Aug. 15, . | No flower stalks in sight,* . . | 4.2 | 27 | 2.48 | None | 6.8 | 7.93 |
| Aug. 16, . | No flower stalks in sight,* . . | 5.8 | 24 | 4.06 | None | 9.0 | 11.10 |
| Aug. 20, . | Flower stalks developed,* . . | 7.9 | 24 | 3.47 | 2.15 | 7.0 | 13.00 |
| Aug. 24, . | Flowers open,* . . . . . . | 8.7 | 23 | 3.70 | 3.00 | 4.0 | 14.07 |
| Aug. 27, . | Plants in full bloom,* . . . | 10.0 | 25 | 3.65 | 4.13 | 10.0 | 15.48 |
| Aug. 30, . | Seed forming,* . . . . . . | 9.5 | 30 | 4.00 | 3.81 | 9.5 | 16.14 |
| Sept. 2, . | Seed in milk,* . . . . . . | 10.7 | 27 | 3.85 | 4.41 | 9.5 | 15.85 |
| Sept. 9, . | Seeds still soft,* . . . . . | 12.1 | 22 | 3.21 | 6.86 | 9.5 | 26.13 |
| Sept. 9, . | Stripped on Sept. 2,* . . . . | 12 8 | 22 | 3.77 | 6.81 | 9.5 | 26.75 |
| Sept. 18, . | Left on field without stripping,* . | 13.2 | 22 | 3.57 | 7.65 | – | – |
| Sept. 18, . | Tops removed,* . . . . . . | 13.8 | 22 | 3.16 | 8.49 | – | – |
| Sept. 18, . | Tops and leaves removed on Sept. 9,* | 11.5 | 22 | 3.16 | 5.85 | – | – |
| Sept. 18, . | Tops removed; left on field 9 days,* | 12.8 | 22 | 10.00 | .60 | – | – |
| Sept. 21, . | Juice from the above,* . . . | 13.0 | 21 | – | – | – | – |
| Sept. 23, . | Juice from the above,* . . . | 15.0 | 18 | – | – | – | – |
| Sept. 25, . | Left on field 3 weeks,† . . . | 19.8 | 21 | 11.91 | 6.27 | – | – |
| Sept. 28, . | Left on field 3 weeks,† . . . | 17.8 | 12 | 16.60 | – | – | – |
| Oct. 4, . | Left on field 3 weeks,† . . . | 16.1 | 17 | 8.62 | 6.16 | 12.0 | – |
| Oct. 7, . | Freshly cut. Ground with leaves,† | 16.7 | 20 | 4.16 | 9.94 | 6.8 | – |
| Oct. 8, . | Freshly cut. Stripped two weeks,† | 12.8 | 17 | 5.16 | 5.27 | 7.0 | – |
| Oct. 9, . | Freshly cut. Stripped two weeks,† | 18.4 | 17 | 7.57 | – | 10.6 | – |
| Oct. 14, . | Several weeks old,† . . . . | 18.2 | 15 | 10.42 | – | 10.4 | – |
| Oct. 18, . | Several weeks old,† . . . . | 15.1 | 23 | 7.57 | – | – | – |
| Oct. 19, . | Several weeks old,† . . . . | 15.5 | 15 | 9.22 | – | 13.6 | – |
| Oct. 22, . | Several weeks old,† . . . . | 16.2 | 16 | 8.30 | – | – | – |
| Oct. 23, . | Several weeks old,† . . . . | 18.3 | 17 | 11.30 | 5.5 | 14.0 | – |
| Oct. 24, . | Several weeks old,† . . . . | 16.6 | 15 | 8.63 | – | 9.0 | – |

| | | 100 Parts of Cane contained — | | | | |
|---|---|---|---|---|---|---|
| | | Moisture. | Glucose. | Cane Sugar. | Total Sugar. | |
| **1889.** | | | | | | Grown on station grounds. |
| October, . | Early Tennessee sorghum, mature, . | 77.43 | 1.79 | 3.21 | 5.00 | |
| October, . | Price's new hybrid, ripe, . . . | 77.80 | 2.92 | 3.78 | 6.70 | |
| October, . | Kansas orange, green, . . . | 80.67 | 2.38 | 3.63 | 6.01 | |
| October, . | New orange, green, . . . . | 78.30 | 2.96 | 3.85 | 6.81 | |
| October, . | Honduras, green, . . . . . | 77.55 | 3.08 | 4.01 | 7.09 | |

* Raised on the college farm. † Raised by farmers in the vicinity of the college.

## *D. Analyses of Sugar-producing Plants* — Concluded.

[Composition of the juice of corn stalks and melons.]

| Variety. | Specific Gravity. | Temperature C. (Degrees). | Glucose. | Cane Sugar in Juice. | Solids. |
|---|---|---|---|---|---|
| | | | Per ct. | Per ct. | Per ct. |
| Northern corn,* | 1.023 | 27 | 4.35 | 0.28 | 15.18 |
| Black Mexican sweet corn,† | 1.048 | 27 | 2.06 | 7.02 | 17.44 |
| Evergreen sweet corn,† | 1.052 | – | 4.85 | 5.70 | 20.38 |
| Common sweet corn,‡ | 1.035 | – | 6.60 | None. | – |
| Common yellow musk-melon,§ | 1.040 | 26 | 1.67 | 2.65 | – |
| White-flesh water-melon, | 1.025 | 18 | 2.91 | 2.16 | – |
| Red-flesh water-melon, | 1.025 | 22 | 3.57 | 2.18 | – |
| Red-flesh water-melon, | 1.025 | 19 | 3.84 | 1.77 | – |
| Nutmeg musk-melon,‖ | 1.030 | 19 | 3.33 | 2.11 | – |
| Nutmeg musk-melon,¶ | 1.050 | 20 | 2.27 | 5.38 | – |
| Nutmeg musk-melon,** | 1.030 | 19 | 2.50 | 1.43 | – |

* Tassels appearing.
† Ears ready for the table.
‡ Kernels somewhat hard.
§ Fully ripe.
‖ Not ripe.
¶ Ripe.
** Over-ripe.

## E. *Analyses of Dairy Products.*

| | Analyses. | Solids. Maximum. | Solids. Minimum. | Solids. Average. | Fat. Maximum. | Fat. Minimum. | Fat. Average. | Curd. Maximum. | Curd. Minimum. | Curd. Average. | Salt. Maximum. | Salt. Minimum. | Salt. Average. | Ash. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Whole milk, | 50 | 16.70 | 11.96 | 13.60 | 5.45 | 2.48 | 3.95 | - | - | 3.20 | - | - | - | .70 |
| Skim-milk, | - | - | - | 10.19 | - | - | .37 | - | - | 3.53 | - | - | - | .80 |
| Buttermilk, | - | - | - | 8.16 | - | - | .21 | - | - | 2.79 | - | - | - | .80 |
| Cream, | 59 | 28.51 | 21.30 | 25.26 | 20.90 | 13.74 | 17.47 | - | - | - | - | - | - | .62 |
| Butter, | 24 | 92.89 | 87.05 | 89.17 | 89.05 | 81.43 | 83.98 | .89 | .51 | .66 | 6.45 | 3.61 | 4.80 | - |
| Whole-milk cheese (Jersey),* | 1 | - | - | 62.84 | - | - | 37.32 | - | - | 22.13 | - | - | - | 3.39 |
| Whole-milk cheese,* | 1 | - | - | 64.17 | - | - | 34.34 | - | - | 26.69 | - | - | - | 3.14 |
| Cheese from milk skimmed after twelve hours' standing,* | 1 | - | - | 62.70 | - | - | 27.81 | - | - | 30.37 | - | - | - | 4.52 |
| Cheese from milk skimmed after twenty-four hours' standing,* | 1 | - | - | 57.76 | - | - | 23.42 | - | - | 31.99 | - | - | - | 2.35 |
| Cheese from milk skimmed after thirty-six hours' standing,* | 1 | - | - | 56.05 | - | - | 17.67 | - | - | 33.24 | - | - | - | 5.14 |
| Cheese from milk skimmed after forty-eight hours' standing,* | 1 | - | - | 54.59 | - | - | 15.77 | - | - | 34.94 | - | - | - | 3.88 |
| Cheese from skim-milk, with addition of buttermilk,* | 1 | - | - | 51.62 | - | - | 18.35 | - | - | 28.63 | - | - | - | 4.64 |
| Genuine oleomargarine cheese,* | 1 | - | - | 62.10 | - | - | 31.66 | - | - | 25.94 | - | - | - | 4.50 |

* From analyses made in 1875.

*E. Salt for Meat Packing and Dairy Purposes.*

| KIND AND SOURCE. | Moisture 100° C. | Sodium Chloride. | Calcium Sulphate. | Calcium Chloride. | Magnesium Chloride. | Sodium Sulphate. | Magnesium Sulphate. | Insoluble Matter. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|
| Rock salt of Pettite Anse, La., | .330 | 98.882 | .782 | .001 | .003 | - | - | - | Sent on for examination. |
| Rock salt of Neyba, San Domingo, W. I., | .300 | 98.330 | 1.480 | - | .090 | .070 | .070 | - | |
| Solar salt, Onondaga, N. Y., | 2.500 | 96.004 | 1.315 | .092 | .089 | - | - | - | |
| Solar salt, Hocking Valley, O., | 2.130 | 97.512 | None. | .234 | .089 | - | - | - | |
| Solar salt, Saginaw Valley, Mich., | 3.344 | 95.813 | .316 | .356 | .140 | - | - | - | |
| Solar salt from Kansas, | 4.950 | 93.060 | 1.220 | - | .240 | .350 | .180 | - | |
| Solar salt, Lincoln County, Neb., | 1.200 | 98.130 | .250 | - | .080 | .390 | None. | - | |
| Common fine and boiled salt, Onondaga, N. Y., | 3.000 | 95.353 | 1.355 | .155 | .136 | - | - | - | |
| Common fine and boiled salt, Portsmouth, Mich., | 6.752 | 90.682 | .805 | .974 | .781 | - | - | - | |
| Common fine and boiled salt, Mason City, O., | 3.470 | 95.789 | - | .614 | .041 | - | - | - | |
| Dairy and table salt, Ashton's (English), | 0.760 | 97.652 | 1.430 | - | .060 | - | .048 | .050 | |
| Onondaga dairy salt, | 0.700 | 97.832 | 1.263 | - | .037 | .026 | .023 | .120 | |
| Fine salt, Bulletin 26, I., | 3.280 | 95.091 | 1.487 | .032 | .075 | - | - | .035 | |
| Fine salt, Bulletin 26, II., | 4.591 | 94.012 | 1.177 | .143 | .049 | - | - | .028 | |
| Fine salt, Bulletin 26, III., | 4.616 | 94.236 | .999 | .071 | .026 | - | - | .052 | Salicylic acid: trace. |
| Dairy salt, sent on from Amherst, Mass., | 0.145 | 98.520 | 1.009 | .189 | .065 | - | - | .072 | |
| Ashton salt (sent on), | .760 | 97.650 | 1.430 | - | .060 | - | .050 | .050 | |
| Onondaga factory-filled (sent on), | .600 | 98.280 | .910 | - | - | .030 | .060 | .120 | |
| Dairy salt, sent on from Amherst, | .505 | 98.202 | .877 | .168 | .016 | - | - | .202 | |
| Rock salt from Retsof salt mines, | 2.600 | 95.940 | .420 | .330 | .010 | - | - | .700 | |
| Royal salt, | .880 | 97.877 | 1.108 | .016 | .010 | - | - | .102 | |
| Excelsior salt, | .320 | 98.009 | 1.644 | .013 | .014 | - | - | .020 | |
| Genesee salt, | .295 | 98.513 | 1.160 | .010 | .012 | - | - | .010 | |
| Genesee salt, | .235 | 98.563 | 1.137 | .045 | .020 | - | - | - | |
| Bradley salt, | .200 | 98.575 | 1.185 | .029 | .007 | - | - | - | |
| Higgin's Eureka salt, | .855 | 98.891 | .906 | .293 | .055 | - | - | - | |
| Worcester refined salt, | .565 | 97.935 | 1.376 | .097 | .027 | - | - | - | |

# METEOROLOGY.

## 1890.

The meteorological observations have been continued as in previous years. The temperature, the force and direction of the wind, and the amount of cloudiness, are recorded each day at 7 A.M., 2 P.M. and 9 P.M. During the summer months the reading of a wet-bulb thermometer is taken at these times. Instruments recording the maximum and minimum temperatures, and measuring the rainfall, are also used.

Besides our regular observations, records are made of casual meteorological phenomena, and the condition of farm crops, trees, etc., as affected by the weather or season.

Monthly and annual reports are sent to the headquarters of the signal service at Washington, D. C., and to the New England Meteorological Society.

During the summer months we have sent weekly weather crop reports to the latter society, and have furnished a partial monthly report for the use of the secretary of the State Board of Agriculture.

The weather during January and February was exceptionally mild, even more so than during 1889. Considerable difficulty was experienced in getting ice. In this vicinity none was cut until February, when it reached a thickness of from six to eight inches.

There was hardly enough snow for good sleighing at any time during the winter. A snow-storm on the 20th of February gave sleighing for two or three days, and one on the 6th of March gave fair sleighing until the 10th. The temperature for March was lower than for either of the preceding months.

The total snow fall for March is recorded as seventeen inches, but with one exception it disappeared soon after falling.

The last heavy frost, during the spring, occurred April 29. Light frosts were reported on the 17th and 23d of May.

The weather during the early part of the season was, on

the whole, favorable to the growth of farm crops. The first crop of hay was large, and most of it was secured in good condition during the dry weather preceding the heavy rain beginning July 24. The crop of rowen suffered somewhat on account of that drought, and other crops suffered to some extent. During the remainder of the growing season there was sufficient rain, most of the time an abundance.

Frost held off remarkably late, the first in the autumn occurring September 25, after which there was none until October 13.

The first trace of snow occurred November 11. There were 15.5 inches during December, with good sleighing most of the time.

The rainfall during the year was slightly above the average, and fairly distributed. The rains during April, June and November, however, were light, being less than two inches in each case.

The heaviest rain of the season occurred on the 24th, 25th and 26th of July, giving a rainfall of 4.65 inches.

From the 9th to the 15th of September it rained every day, giving 2.57 inches, and on the 17th of that month there was a fall of 1.50 inches. A storm on the 23d and 24th of October gave 2.30 inches.

During the year there were one hundred and fifty days recorded as "cloudy," seventy-one as "clear." The greatest number of cloudy days, seventeen, occurred in October, and the greatest number of clear days, nine, in November and December. In August there were but three clear days.

The prevailing wind during six months of the year was north-west. It was north-east during March, April and August, south-east during May and June, and south during July.

The mean annual temperature for the year, 46.43°, was about the average. The principal variations from the monthly average temperatures occurred in January, which has had a higher temperature during the period covered by the Amherst observation only in 1838, 1870 and 1880. February also was considerably warmer than usual. The average for December is the lowest since 1876.

The highest temperature during the year was 92°, occurring July 8; the lowest, — 9.5°, occurring March 7.

## Summary of Meteorological Observations, 1890.

| | Temperature, Degrees Fahrenheit. | | | | | | | | | | | Relative Humidity, Per Ct. | | | | Precipitation, Inches. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7 A. M. | 2 P. M. | 9 P. M. | Mean. | Maximum. | Minimum. | Range. | Absolute Maximum. | Date. | Absolute Minimum. | Date. | 7 A. M. | 2 P. M. | 9 P. M. | Mean. | Depth of Water. | Date of Greatest Fall. |
| January, . . | 26.7 | 35.1 | 30.1 | 30.5 | 39.8 | 21.5 | 18.3 | 61.5 | 2d | 4.5 | 25th, | - | - | - | - | 2 61 | 15th-16th |
| February, . . | 26.6 | 36.0 | 30.4 | 30.8 | 39.9 | 22.5 | 17.4 | 59.5 | 26th | 3.0 | 22d, 23d | - | - | - | - | 4.01 | 8th |
| March, . . | 25.1 | 35.6 | 30.0 | 30.2 | 38.9 | 21.6 | 17.3 | 59.5 | 12th | —9.5 | 7th | - | - | - | - | 4.81 | 22d, 23d |
| April, . . | 38.6 | 55.2 | 44.0 | 45.5 | 57.6 | 32.8 | 24.8 | 77.5 | 13th | 22.0 | 19th | - | - | - | - | 1.64 | 4th |
| May, . . . | 51.6 | 64.9 | 54.6 | 56.4 | 67.6 | 44.7 | 22.9 | 79.0 | 14th | 32.0 | 2d, 12th | 84.1 | 60.9 | 76.2 | 73.7 | 5.14 | 26th-27th |
| June, . . . | 60.2 | 73.2 | 62.5 | 64.6 | 76.3 | 53.1 | 23.2 | 86.5 | 30th | 38.0 | 3d | 83.7 | 57.4 | 78.4 | 73.2 | 1.48 | 5th-6th |
| July, . . . | 63.6 | 77.0 | 65.9 | 68.1 | 79.7 | 56.2 | 23.5 | 92.0 | 8th | 41.0 | 10th, 21st | 85.0 | 54.0 | 78.3 | 72.4 | 5.44 | 24th-26th |
| August, . . | 62.5 | 74.3 | 64.3 | 66.3 | 76.6 | 57.2 | 19.4 | 86.0 | 4th, 6th | 41.5 | 25th | 89.8 | 61.1 | 83.6 | 78 2 | 4.60 | 19th-20th |
| September, . | 54.4 | 67.3 | 57.9 | 59.4 | 69.7 | 50.3 | 19.4 | 78.5 | 2d, 7th | 29.5 | 25th | 93.4 | 68.8 | 89.0 | 83.7 | 5.28 | 17th |
| October, . . | 42.5 | 55.1 | 46.1 | 47.4 | 56.8 | 39.3 | 27.5 | 76.0 | 1st | 26.5 | 22d | 89.1 | 61 2 | 83.8 | 78.0 | 6.89 | 16th-17th |
| November, . | 32.4 | 43.2 | 34.7 | 36.3 | 46.0 | 27.5 | 18.5 | 60.0 | 6th | 13.0 | 28th | - | - | - | - | 1.24 | 17th |
| December, . | 18.6 | 25.1 | 21.6 | 21.7 | 36.2 | 5.4 | 30.8 | 42.5 | 23d | —5.5 | 30th | - | - | - | - | 3.18 | 26th |
| Sums, . . | 502.8 | 642.0 | 542.1 | 557.2 | 685.1 | 432.1 | 253.0 | 858.5 | - | 236.0 | - | 525.1 | 363 4 | 489.3 | 459.2 | 46.32 | - |
| Means, . . | 41.90 | 53.50 | 45.18 | 46.43 | 57.09 | 36.01 | 21.08 | 71.54 | - | 19.67 | - | 87.52 | 60.57 | 81.55 | 76.53 | 3.86 | - |

*Miscellaneous Phenomena, — Dates.*

| | Frost. | Snow. | Rain. | Thunder-storms. | Lunar Halos. |
|---|---|---|---|---|---|
| January, . . | 4, 19, 23, | 10, 11, 23, 31, | 1, 5, 6, 10, 11, 12, 13, 15, 16, 20, 27, 30. | - | - |
| February, . . | 7, 14, | 2, 7, 10, 20, | 4, 7, 8, 14, 17, 18, 24, 25, 28. | - | 1. |
| March, . . | 24, | 3, 5, 6, 15, 19, 28, 29, 31, | 1, 11, 14, 21, 22, 23, 25, 26, 28. | 28, | 45, 24. |
| April, . . . | 2, 3, 6, 8, 12, 16, 20, 21, 29. | - | 4, 7, 8, 9, 25, 26, 27, | - | 29. |
| May, . . . | 17, 23, | - | 1, 3, 4, 5, 6, 10, 11, 14, 15, 16, 17, 20, 26, 27, 28. | 14, 28, | - |
| June, . . . | - | - | 3, 4, 5, 6, 12, 13, 14, 15, 19. | 5, 6, | - |
| July, . . . | - | - | 3, 4, 7, 15, 19, 24, 25, 26, 31. | 7, 19, 26, 31, | - |
| August, . . | - | - | 1, 9, 10, 12, 17, 18, 19, 20, 21, 22, 23, 26, 27, 30. | 17, 19, | - |
| September, . . | 25, | - | 5, 6, 9, 10, 11, 12, 13, 14, 15, 17, 26. | 17, | - |
| October, . . | 13, 16, 22, 23, | - | 4, 6, 7, 8, 10, 14, 16, 17, 19, 20, 23, 24, 25, 29, 30. | - | 22, 25. |
| November, . . | 1, 3, 4, 5, 6, 13, 14, 15, 21, 24, 26, 30. | - | 2, 9, 11, 15, 17, | - | - |
| December, . . | 2, | 3, 5, 6, 26, 30, | 3, 17, 18, 21, | - | 16, 25. |

C. A. GOESSMANN,
*Director.*

# ANNUAL REPORT OF FRANK E. PAIGE,

TREASURER OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION,

*For the Year ending Dec. 31, 1890.*

RECEIVED.

| | | |
|---|---|---|
| Cash from Dr. J. P. Lynde, balance of last year, | $15 00 | |
| Cash from State Treasurer, appropriation, | 10,000 00 | |
| Cash from farm, etc., | 1,422 07 | |
| Cash from fertilizer account, | 1,905 00 | |
| | | $13,342 07 |

EXPENDED.

| | | |
|---|---|---|
| Cash paid salaries, | $4,478 03 | |
| Cash paid laboratory supplies, | 1,213 01 | |
| Cash paid printing and office expenses, | 838 34 | |
| Cash paid farmer and farm labor, | 2,050 10 | |
| Cash paid farm stock and feed, | 1,278 96 | |
| Cash paid incidental expense, | 899 93 | |
| Cash paid construction and repairs, | 599 22 | |
| Cash paid expense of board of control, | 75 62 | |
| Cash paid fertilizer account, | 1,565 00 | |
| Cash on hand, | 343 86 | |
| | | $13,342 07 |

# SUMMARY OF THE PROPERTY OF THE MASSACHUSETTS STATE AGRICULTURAL EXPERIMENT STATION.

*(Dec. 31, 1890.)*

| | | |
|---|---|---|
| Buildings, etc., | $30,702 00 | |
| Farm inventory (live stock, crops, etc.), | 2,299 45 | |
| Office furniture (chemical laboratory), | 1,456 75 | |
| Chemicals and chemical apparatus (chemical laboratory), | 2,605 95 | |
| Furniture, herbariums and library (agricultural and physiological laboratory), | 903 25 | |
| Instruments, apparatus, etc. (agricultural and physiological laboratory), | 822 10 | |
| Total of inventory, | | $38,789 50 |

BOSTON, MASS., Jan. 8, 1891.

This is to certify that I have examined the books and accounts of Frank E. Paige, Treasurer of the Massachusetts Agricultural Experiment Station, for the fiscal year ending Dec. 31, 1890, and find them correct, and all disbursements properly vouched for, with a balance of cash in treasury of three hundred forty-three dollars and eighty-six cents, which is shown to be in bank.

W. R. SESSIONS,
*Auditor.*

# INDEX

## TO EIGHTH ANNUAL REPORT, 1890.